No. 18. 1909.

*(UNIVERSITY OF LONDON.)*

COUNTY COUNCILS OF KENT & SURREY.

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# THE JOURNAL

OF THE

# South-Eastern Agricultural College,

WYE, KENT.

HEADLEY BROTHERS,
PRINTERS AND PUBLISHERS,
LONDON AND ASHFORD, KENT.

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# EDITORIAL NOTES.

The College still maintains its advance in every department of its work, and by whatever standard it be judged it may be claimed that its usefulness has not diminished. The number of students shows an increase and the quality of the work shows an improvement each year. The extension of the Diploma Course to three years has undoubtedly had a considerable influence, and the increase of the number of students in the Degree Course has the effect of raising the standard of the highest work of the College in a way which reacts all through the other courses. The re-organisation of the practical farm teaching has had excellent effects, and has resulted in the turning of students' attention to their own self-instruction, and in encouraging a spirit of observation and inquiry, instead of merely looking with unseeing eyes and passive intelligence. The intention of those governing and directing the College is to make the farms as interesting and educational as possible, and by the variety of stock, crops and methods to encourage a general view being taken of agriculture, so that in after life, wherever it be spent, a student will not find everything strange, but will be prepared for all sorts of conditions, and have an open mind to deal with them on the most satisfactory lines.

The ratepayers of the counties who contribute to the finances of the College show that they appreciate the opportunities offered them to take advantage of its educational and other advantages. The sixty places reserved at special fees for Kent and Surrey rate-payers are continuously occupied, and there are often more applicants than vacancies. The services of the staff for advice are very largely utilised, and the inquiries on points of importance to agriculturists, fruit and hop-growers total well over 5,000 ; whilst the visits of farmers, etc., to the College have been largely increased in number.

Of an institution of the nature of a technical college there always will be severe critics, who are sometimes opposed to scientific education of any sort, and who often resent the carrying on of an institution on any lines but the most severely " practical."

Wye College is not meant for the sons of any particular class; all rate-payers or their sons who intend to earn their livelihood by agriculture or horticulture are welcome to its opportunities. It would be a strange condition to insist on, if medical colleges, or engineering colleges, were reserved entirely for doctors' or engineers' sons respectively; yet there are those who would insist on an agricultural college being reserved for farmers' sons, when it is the non-agricultural parent who wants opportunities for his son's education, which the agricultural parent is able to and generally does give his son on his own farm, when the son is to follow the business of farming.

If the occupations of the parents of students attending the long courses (two years) at Agricultural Colleges in this country or abroad, be analysed, it will be seen how few farmers' sons there are. In addition to the already mentioned reason, time and expense and perhaps a certain amount of prejudice are the operating factors.

---

We have again to record with regret the departure of several members of the staff, but it is satisfactory to record that these form no exception to the rule which seems to obtain that departures mean preferment, and the congratulations of the College are due to them for their well-deserved promotion.

Mr. B. N. Wale, B.Sc. (Senior Lecturer in Agriculture) has been appointed the first Principal of the Seale Hayne Agricultural College in Devonshire.

Mr. C. T. Gimingham (Bacteriologist) has been appointed to take charge of the new department of Agricultural Chemistry at University College, Bristol; he was succeeded by Mr. C. J. Alexander, B.Sc. (an old student), who was soon appointed consulting mycologist to the Berkshire County Council. Mr. G. H. Garrad (an old student) has been appointed to succeed Mr. Alexander, and Mr. Garrad's Indian experience will stand him in good stead for teaching tropical agriculture to those students who intend applying for Colonial appointments or to proceed to the Colonies on the completion of their course.

Mr. S. J. K. Eames, S.E.A.C.Dip. has been appointed as an assistant Agricultural Lecturer. Mr. Eames has, since he left the College, been in charge of his father's farm, on which a considerable acreage of hops is grown, at Midhurst, Sussex.

Mr. R. N. Dowling, S.E.A.C.Dip. (assistant agricultural lecturer), has obtained a very promising farm partnership in Cambridgeshire, and is succeeded by Mr. G. G. Macdonald, B.Sc. Aberdeen, a successful Scotch farmer's son.

Mr. R. Hart Synnot, B.Sc., who as a College student took an active part in many departments of College life, has been appointed to succeed Professor Percival as Director of the Agricultural Department of University College, Reading.

Mr. R. S. Biscoe, S.E.A.C.Dip., succeeds Mr. E. T. Bruce as Lecturer on Surveying, etc., at the Aspatria Agricultural College; and Mr. W. N. Harvey, S.E.A.C.Dip., is Assistant Chemist at the Harper Adams Agricultural College.

Mr. D. Turner, S.E.A.C.Dip., has been appointed Professor of Agriculture at the Royal Agricultural College, Cirencester.

Messrs. K. G. Furley and R. S. Vinson, S.E.A.C.Dip., have been appointed by the Kent County Council Inspectors of American Gooseberry Mildew. Mr. C. J. Alexander also acted in this capacity.

Messrs. R. H. Spooner, T. G. O. Cole and W. McGowan have received appointments as estate agents. Messrs. C. B. Saunders, B.Sc., H. P. Easten and J. B. Love are with Mr. T. J. Young at Holmes Chapel. Mr. E. W. Pullen has been appointed District Surveyor to the Hertfordshire County Council.

A number of old students who have left the College within the past few years, after having gained experience in commercial farming, are now settled in various parts of the country, and good reports are received of their doings.

Of the students who have sought their fortunes abroad, quite a number are settled or working in British Columbia and other parts of Canada; amongst them Messrs. G. M. Gibson, J. H. Rammell, J. F. Harrison, H. W. Harding, F. H. Vaughan, J. R. Cheeseman, A. Newbold, H. C. H. Barnes, W. G. M. Foster, J. C.

Curtis, H. W. Peake, B. T. Dane; whilst Messrs. E. T. Bruce, L. E. Knollys, W. Hopkins, S. Rothwell, C. W. Jemmett, and W. R. Dunlop, have received appointments under the Colonial Office. Messrs. H. Tonks, G. Harbord, H. F. Dalton, and C. W. Fisher are in responsible positions in Ceylon. Messrs. H. F. Foster Pegg and F. G. Jackson are officials in Burmah; Mr. F. P. Jepson is Entomologist in Fiji; Mr. H. E. Annett, B.Sc., is acting Imperial Chemist to the Government of India; and Mr. H. A. Clive is managing an estanza in the Argentine.

The variety of the work, both at home and abroad, undertaken by those who have passed through the College is an evidence of the general value of the College training, and also of the opportunities which such training opens up for young men, and one of the functions of a technical college is to give to its students openings for earning their own livelihoods, which but for the College training perhaps, would be denied to them.

It is, unfortunately for this country, necessary for young men of grit and physical competence, who have not sufficient capital to farm here, to go to the colonies, where the man of small capital and large capacity for manual work has a good future.

---

There seems now a definite prospect of the State devoting an increased amount of money for the benefit of English agriculture, through the operation of the Development Act, and as this means State help to education and research in agricultural and horticultural matters, a wise application of the funds should do much to put these matters on a more satisfactory basis.

It would seem desirable to give the Board of Agriculture the opportunity for development it has so long wanted and waited for. At present the housing and equipment of the Government office, which should be one of the most important State departments, is not a credit to any Government. There is work ready and waiting to be done which the Board cannot do for want of financial aid, and the farmer and fruit-grower and all agriculturists should, by every means in their power, press upon the Government the importance of equipping the Board with all the technical and scientific assistance which is considered necessary for developing and guarding the interests of the great industries of which it has charge. It may have been thought from opinions expressed in a recent number of this *Journal* that it was the personnel of the Board which was being criticised, but our complaint is that of every agriculturist, that successive Governments refuse to so endow the Board of Agriculture as to bring it to a full measure of usefulness. What has been done for the Irish Board should be done for the English Board, and no one doubts that a full or a fuller advantage would be taken of the increased opportunities. When we consider what the Board with its limited resources, has done for agricultural education, by its sympathy and advice as well as by its grants, we can congratulate it upon the educational structure it has raised, and look forward with confidence to a further development of its activities.

# REPORT

ON THE

# FARM AND GARDENS.

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# THE FARM.

The use of the farms for teaching purposes has been largely extended by the re-organisation of the agricultural teaching.

There are still left those who contend that a college farm should simply demonstrate local practice and be made a paying concern, and that students, no matter from whence they came or where their future lives as farmers will be spent, should only be made familiar with the conditions of farming of that district where the college is situated.

On the College farms two typical rotations are practised, the four-course and the six-course, mainly as fixed systems for students' instruction, not with the idea that no elasticity should be shown in farming, and that a man because he states that he is going to farm on a certain "shift" should be blamed if he finds it to his advantage to modify his plans. It matters little what rotation of crops be employed as long as the land be kept clean and its condition maintained by suitable manuring and cultivation.

A remark made at a recent public meeting: "There is no necessity to keep so many breeds of live stock at the College farm, the authorities there should have found out by now which breeds do the best," shows the criticism of one who misses the object and point of keeping a variety of live-stock: (1) to familiarise the students with the different breeds, and (2) to give them a practical demonstration of the fact that the live stock generally found in the district are there because they are as a rule better doers than the "strangers."

The demonstrations on cropping, cultivation, manuring and feeding are all designed with the double object of giving the student a greater interest in the ordinary farm stock and crops by showing him variations in practice, and also to drive home the points urged in lecture with regard to the effects of different systems and methods of practice. The word experiment cannot be applied to these trials, and except in a few cases the results are not recorded; they are not designed with the view of investigation, but merely to show in a practical form the results of different systems, good and bad, of management.

A trial was made of the effect on the quality of Red Fife wheat as influenced by early or late sowing, but it was found that the millers' expert opinion of the grain which was milled and baked, was that February, March, or April sowing seemed to make no difference in the value of the flour. The superiority of Fife wheat to English wheat was estimated by them in the proportions of 88 to 68.

A small breadth of Australian wheat "Federation" was sown, but the crop was entirely ruined by rust, to which it seems specially liable, and not a single sound grain was harvested, the straw being also useless. This afforded an excellent demonstration to students and others of the havoc that can be wrought in a wheat crop by rust.

The prices of corn and stock of the 1908 and 1909 seasons were satisfactory, but the corn harvest was badly spoiled by the weather, especially in 1909. The following were the chief prices :—

| | | |
|---|---|---|
| Barleys. | 1908. | Potter's Chevalier, 28s., Burton Malting, 32s. |
| | 1909. | Standwell, 32s. 6d., Burton Malting, 32s. 6d., Chevalier, 32s. 6d. |
| Wheats. | 1908. | Tiverson's, 33s. 6d., Red Giant, 33s. 6d. Red Fife, 37s. |
| | 1909. | Tiverson's, 38s. 6d.—42s., White Standup, 37s., Double White, 37s., Mixed Red Wheat, 38s. |
| Oats. | 1908. | Blacks, 25s. |
| | 1909. | Cluster and Abundance, 21s. to 25s. |
| Potatoes. | 1908. | Lates 60s. per ton on rail. |
| | 1909. | Lates 65s. per ton on rail. |

Sheep. 1908. The culls from the Kent flock, Suffolks, Lincolns, etc., averaged 40s. for ewe tegs ; draft ewes, 33s. 6d. to 39s. ; broken mouths, 25s. 6d. to 29s. ; Southdown ram tegs from 4 to 7½ guineas ; Southdown ram lambs, 55s. to 70s. ; ewe tegs, 44s. ; one lamb ewes, 45s. ; regular draft, 46s. ; Southdown ewe tegs, 44s., 45s., 49s. 6d. 1909. Southdown ewes, 28s. to 50s. ; ram tegs, 4½ to 5½ guineas ; Oxford, Lincoln and Suffolk culled ewes, 23s. to 30s. ; culled Kent ewes, from 30s. to 36s.

Pigs. 8s. 3d. to 12s. per score.

Beef. 12s. per score, at home.

Milk. 9d. to 9½d. per gallon.

Wool made (1909) 13¾d. (Southdown) ; 10¼d. (Kent) ; 8¾d. (half bred) ; at Guildford ; whilst at Ashford, Kent ewes realised 10¼d. ; lamb wool, 8¾d. ; and a few Southdown fleeces made 1s. 2¼d.

The Kent wethers gained second prize at the (1908) Tonbridge Show ; at the Ashford Show, two first prizes for oats, and one first prize for barley were obtained, and reserve cards for Southdown wethers, Southdown lambs, and in the carcase competition and for wheat were also obtained.

In 1909 first prize for potatoes, first for red wheat, first for white wheat, and first for white oats was obtained at Tonbridge ; and at Ashford five first prizes for corn, one second and one reserve to first were obtained.

The usual Winter demonstrations of feeding were carried on, in both 1908 and 1909, and results specially useful to students were obtained.

# A DEMONSTRATION OF INTENSIVE CULTIVATION.

The following record of an experiment in intensive cultivation is not put forward as either original or as due to any special skill in management or marketing, but as a possible suggestion to small holders for the utilisation of their opportunities for growing crops which can be marketed through the ordinary wholesale or retail channels in small or large quantities. The relation of the experience may evoke the criticism that the results are due to an exceptional season and exceptional conditions of sale. Exceptional seasons, however, occur nowadays with some frequency, and the conditions under which the produce in this case was marketed did not differ from those obtained by many alert and business-like producers.

On the Wye College farm each year are grown some thirteen to twenty acres of potatoes, this area being devoted to earlies, mid-season, and late varieties. In 1908 some six acres were set with earlies in Wye field, the soil of which is a fairly deep useful loam with the chalk some distance below, rented at 30s. per acre, lying at an altitude of 160 feet and unsheltered. The previous crop was oats, of which a yield of 9½qr. was obtained, and the land was in good heart and clean. The varieties of earlies grown on the area under experiment, 145 rods, or 0.906 acre, were Epicures and May Queens ; the sets were sprouted in boxes, and planted on April 7th. The cultivation and manuring of the crop were as follows :— The oat stubble was dunged with twenty-five loads of farmyard manure per acre, shallow ploughed in November just to cover the dung ; deep ploughed two months later, ridges drawn and artificials sown, boxed sets planted, ridges split to cover seed ; saddle-harrowed down three weeks later ; ploughed with chilled plough between ridges, immediately harrowed down ; hand-hoed and earthed up. The artificials sown comprised 3 cwt. superphosphate of lime, 1½ cwt. sulphate of potash and 1½ cwt. sulphate of ammonia. The cost of these operations, including rent, manure, seed, digging, and carrying to station is calculated at £16 5s. per acre. The crop, which averaged 9 to 11 tons per acre, was sold f.o.r. at prices from 70s. to 90s. per ton, commencing July 7th, in a not over-favourable market. The gross return per acre was £37 1s. 4d., and the net return, after deducting rail expenses, £1 10s. 4d., and cultivation, etc., expenses, £16 4s., amounted to £19 7s. per acre. Directly after digging, the land was ploughed (this ploughing perhaps might have been omitted), and cauliflower plants were put in ; the season was very dry, and a day or two might have been gained under more favourable conditions. As it was, the plants were watered in, with the result that there was no flagging, and they got a good start. The plants were put in at the rate of 10,000 per acre at a cost of 4s. per 1,000 for plants. A hundredweight of nitrate of soda was given them, and they were hand-hoed once and horse-hoed twice. Selling began on October 28th, when consignments were sent to the Borough Market, London, Bexhill, and some few were sold locally in Wye and Ashford. In all, 7,770 heads were marketed at an average price of 1.135d. per head, realising per acre £40 11s. 4d. The cost of plants, labour, manure, cutting, packing, delivery, rail charges, commission, and returns of empties (they were packed in nets and potato " pads ") amounted to £10 18s. 9d. per acre, so that there was a net return of £29 12s. 7d. per acre, which, with the net return of the early potatoes, makes a total of £48 19s. 7d. per acre from the two crops. It will be noticed that the whole of the manure applied is debited to the crops, but it is intended to take a crop of oats on the ground this year (1909) without further manuring. The crop of oats, 1909, yielded 8½ qrs. per acre. The detailed costs are as follows :—

*Cost of Growing Early Potatoes*, 1908, *per Acre.*

| | | | | £ | s. | d. |
|---|---|---|---|---|---|---|
| Rent and rates shared between potato and cauliflower crop | | | | 1 | 2 | 6 |
| Cost of artificials .. .. .. .. .. .. | | | | 2 | 0 | 0 |
| Dung : 20 tons at 5s. .. .. .. | 5 | 0 | 0 | | | |
| Spreading .. .. .. .. | | 3 | 0 | | | |
| Carting out .. .. .. .. | | 14 | 0 | | | |
| | | | | 5 | 17 | 0 |

| | £ | s. | d. |
|---|---|---|---|
| Cost of seed, 15 cwt. | 3 | 0 | 0 |
| Labour, sprouting in boxes | | 1 | 6 |
| Shallow ploughing | | 8 | 0 |
| Deep ploughing | | 10 | 0 |
| Cultivating or harrowing | | 2 | 6 |
| Ridging | | 2 | 6 |
| Mixing and sowing artificial manures | | 1 | 0 |
| Planting sprouted sets | | 5 | 0 |
| Splitting ridges | | 2 | 6 |
| Saddle harrowing | | 1 | 0 |
| Chilled ploughing or grubbing | | 2 | 6 |
| Saddle harrowing (twice) | | 2 | 0 |
| Horse hoeing or cultivating | | 2 | 0 |
| Hand hoeing | | 4 | 6 |
| Earthing up (1 horse) | | 2 | 0 |
| Machine digging, gathering, sorting, weighing, packing | 1 | 12 | 6 |
| Carting to station | | 5 | 0 |
| Total cost per acre | £16 | 4 | 0 |

*Note.*—Three-quarters of a ton of chats were used for pigs and cows, value 15s. No account is taken of these.

### *Cost of Growing Cauliflowers,* 1908, *per Acre.*

| | £ | s. | d. |
|---|---|---|---|
| Rent and rates shared between two crops | | 10 | 0 |
| 10,000 plants at 4s. per 1,000 | 2 | 0 | 0 |
| Shallow ploughing | | 8 | 0 |
| Harrowing and marking for planting | | 1 | 9 |
| Planting and watering in (11 men and 1 horse) | 1 | 12 | 6 |
| 1 cwt. nitrate of soda and sowing | | 12 | 6 |
| Hand hoeing | | 4 | 0 |
| Two horse hoeings | | 6 | 0 |
| Cutting, packing and carrying | 5 | 4 | 0 |
| | £10 | 18 | 9 |

*Note.*—No account is taken of the sheep-keep left after the crop was cut.

In all the estimates of cost of horse and man labour the cost price is used, the profit on the labour being, of course, in the profit on the crops.

It is not argued that such a result can be obtained always, or that by a great increase of the area a proportionate increase in the returns may be expected, but as it has been done under not the most favourable conditions it may be done again. The estimated labour represents one-fourth of a man's working time for twelve months, this estimate including the extra labour which would be required at the busier times, so that it would appear that such a venture might prove remunerative for small holders under certain conditions. In the event of the cauliflowers failing to head, or the crop not being marketable from any other cause, they will prove suitable sheep feed, and the value need not be entirely lost. The capital required is that for the first crop only, since the returns from the potatoes are available for the expenses of the cauliflower crop.

## NOTE ON 1909 TRIAL.

In this season the early potatoes were grown on the thin chalk land, just below the road separating Sidelands from the arable land at Cold Harbour. The soil here is a sticky thin loam, very close to the chalk, and is one of the poorest pieces on the College farms, the rent of the land being about 15s. per acre ; 7½ acres were devoted to early potatoes, the preceding crops being, oats 1908, after tares carted off 1907. The cultivations and manuring were the same as those described for Wye field in 1908, the varieties of potatoes being "May Queen," "Epicure," "Sharpe's Express," "Eclipse," "Edina," "British Queen" and "Russet Queen." A total of 65 tons 11 cwts. of ware was sold off the field for a sum of £217 17s. 6d. There was left about 7 tons of seed, value about £30, and 3 tons of chats, value £4, so that the gross return was £251 off the 7½ acres. Prices varied from £2 17s. 6d. to £6 per ton. The ground was then planted with cauliflower, sprouting and spring broccoli, curly kale and coleworts (locally known as collards). The season was quite unsatisfactory for the broccoli and cauliflower the continuous wet and absence of sun militating against the "heading" of the crops, and the market was over-stocked with greens, so that it was considered desirable to feed off the crops with the exception of the kale and sprouting broccoli.

Some of the Collards were sold at 1s. 3d. per bag, but the sale was not very brisk. Later in the season the price went up to 1s. 4d. per bag of 45 lbs., realising some £6 net per acre, the greater part being left for sheep which were folded on during March, and at the end of the month the land was ploughed and drilled with oats. The cost of growing and marketing the portion of the crop sold was £4 10s. per acre, so that the net profit per acre was 30s., plus the value of the sheep keep. This result was secured in a season which may be regarded as most unfavourable, both as regards the conditions of growth and of marketing.

On an adjoining piece of land a catch crop of thousand-headed kale, following winter barley and rye fed off by sheep was grown, the intention being to feed this kale off with the Southdown ewes and lambs, but there being an abundance of keep for them, it was decided, owing to the shortness of greens in the markets in the spring of 1909, to sell the crop as vegetables. The price obtained was 1s. per bag of 56 lbs., and the sale of the crop in this way realised £11 14s. per acre at home. The kale was then allowed to shoot again; part was fed off with sheep and afterwards put in with barley, half an acre being reserved for seed in order to demonstrate to the students the methods of growing and harvesting kale seed. This seed was harvested under unfavourable conditions of weather, and it was estimated that only about three-fourths of the crop was got in in good condtiion. This was sold, and realised 6d. per lb., approximately £14 per acre. The total yield of the kale crop was thus about £25 per acre. Of course, it will be necessary to reinforce the manuring of the ground, especially where the seed was grown, but this is only following the elementary law for keeping up the condition of the soil. The up-to-date farmer is one who crops his land heavily and manures it heavily, and so maintains it in condition as a rent and profit paying instrument of his business.

# BULLOCK FEEDING EXPERIMENT.

G. B. PINYON, Dip. S.E.A.C., and B. N. WALE, B.Sc. (Agric.)
Lond.

*Objects of the Experiment.*

1. A comparison of a treacle food—molascuit, with roots, as a fattening ration—a repetition of last year's experiment.
2. Light *versus* heavy cake ration.
3. Animals tied in stalls *versus* loose in covered yards.

*The Cattle and their Arrangement.*

Eleven two-year-old Galloway bullocks were carefully weighed and divided into three lots as follows :—

| | Lot I. (Roots.) Nos. | Lot II. (Molascuit.) Nos. | Lot III. (Extra cake.) Nos. |
|---|---|---|---|
| Tied in Stalls | 1<br>2 | 5<br>6 | 9 |
| Loose in Covered Yards | 3<br>4 | 7<br>8 | 10<br>11 |

*Foods and Feeding.*

The foods and the quantities in which they were fed are given in the table below, the concentrated food was periodically increased during the experiment, and ranged between the limits shown by the figures in Table B, p. 23.

The bullocks were allowed water *ad libitum*, and the quantity actually drunk by the animals was ascertained during a period of forty-two days, which was as follows :—

| | Lot I. | Lot II. | Lot. III. |
|---|---|---|---|
| Gallons per head per day .. | 2.35 | 4.94 | 2.21 |

*Live and dead weights, daily gains* and percentage of carcase to live weight are given below :—

TABLE A.

| | | Number of Bullock. | First Weight. | | | Final Weight. | | | Average daily increase in lbs. Live Weight over whole fattening period. | Average ditto for "tied" and "loose" animals. | Dead Weights. | Per cent. of Carcase to Live Weight. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | cwts. | qrs. | lbs. | cwts. | qrs. | lbs. | | | scores. lbs. | |
| LOT I. | Tied. | 1 | 10 | 0 | 12 | 11 | 1 | 12 | 1.73 | 1.47 | 32.16 | 53.60 |
| | | 2 | 9 | 0 | 0 | 10 | 2 | 2 | 1.21 | | 29.12 | 53.50 |
| | Loose. | 3 | 9 | 2 | 0 | 10 | 3 | 8 | 1.33 | 1.33 | 32.14 | 56.01 |
| | | 4 | 9 | 2 | 21 | —— | | | —— | | — | —— |
| | | Average. | **9** | **2** | **8** | **10** | **3** | **13** | **1.42** | | **31.14** | **54.37** |
| LOT II. | Tied. | 5 | 10 | 0 | 10 | 11 | 3 | 16 | 2.34 | 2.13 | 33.12 | 52.56 |
| | | 6 | 9 | 1 | 0 | 11 | 2 | 19 | 1.93 | | 33.14 | 54.86 |
| | Loose. | 7 | 9 | 2 | 10 | 11 | 0 | 22 | 2.01 | 1.98 | 33.1 | 54.68 |
| | | 8 | 9 | 1 | 16 | 11 | 0 | 4 | 1.96 | | 31.2 | 52.59 |
| | | Average. | **9** | **2** | **9** | **11** | **1** | **22** | **2.06** | | **32.17** | **53.67** |
| LOT III. | Tied. | 9 | 9 | 1 | 10 | 10 | 2 | 23 | 1.44 | 1.44 | 33.6 | 57.69 |
| | Loose. | 10 | 10 | 0 | 2 | 11 | 2 | 12 | 3.01 | 2.20 | 33.16 | 51.51 |
| | | 11 | 9 | 3 | 12 | 10 | 3 | 0 | 1.40 | | 33.7 | 57.59 |
| | | Average. | **9** | **2** | **26** | **11** | **0** | **2** | **1.95** | | **33.9** | **55.59** |

No. 4 bullock in Lot I. turned out to be a very nervous animal and did badly, its weight and rate of progress are therefore omitted.

The bullocks were sent to the butcher as they became finished, which required a period of from three to four months feeding.

TABLE B.

| Foods. | Lot I. | | Lot II. | | Lot III. | |
|---|---|---|---|---|---|---|
| | Commencement. | Finish. | Commencement. | Finish. | Commencement. | Finish. |
| Roots .. | 28 | 56 | none | none | 28 | 56 |
| Chaffed Straw .. | 5 | 6 | 6 | 11 | 5 | 6 |
| Hay .. .. | 5 | 5 | 5 | 5 | 5 | 5 |
| Rice Meal .. .. | 2 | 3 | 2 | 3 | 2 | 3 |
| Linseed Cake .. | 1½ | 2 | 1½ | 2 | 2 | 5½ |
| Cotton Cake .. | 1½ | 2 | 1½ | 2 | 2 | 5½ |
| Molascuit .. | none | none | 2 | 4 | none | none |

*Monetary Returns.*

The value per ton of home-grown food and actual price paid for purchased foods are also given, and in addition the value of their manurial residues as based on Hall and Voelcker's figures :—

| | Price of Food per ton. | | | Value of Manurial residue per ton of food consumed. | | |
|---|---|---|---|---|---|---|
| | £ | s. | d. | £ | s. | d. |
| Roots | | 7 | 6 | | 3 | 0 |
| Straw Chaff | 1 | 5 | 0 | | 7 | 0 |
| Hay | 3 | 0 | 0 | 1 | 1 | 9 |
| Rice Meal | 5 | 18 | 0 | | 14 | 3 |
| Linseed Cake | 8 | 10 | 0 | 1 | 18 | 7 |
| Cotton Cake | 5 | 10 | 0 | 1 | 13 | 9 |
| Molascuit | 5 | 0 | 0 | | 7 | 6 |

TABLE C.

| | Lot I. Roots 3 animals. | | | Lot II. Molascuit 4 animals. | | | Lot III. Extra Cake 3 animals. | | |
|---|---|---|---|---|---|---|---|---|---|
| | £ | s. | d. | £ | s. | d. | £ | s. | d. |
| Cost of food consumed .. | 13 | 16 | 4 | 17 | 9 | 8 | 13 | 6 | 8 |
| First cost of steers at 32s. per cwt. live weight .. | 45 | 18 | 9 | 62 | 5 | 8 | 46 | 14 | 3 |
| Total Cost .. | 59 | 15 | 1 | 79 | 15 | 4 | 60 | 0 | 11 |
| Value of fat bullocks at 12s. per score .. | 57 | 1 | 1 | 78 | 17 | 3 | 60 | 5 | 4 |
| Value of manurial residue .. | 3 | 18 | 5 | 3 | 17 | 5 | 3 | 14 | 1 |
| Total returns .. | 60 | 19 | 6 | 82 | 14 | 8 | 63 | 19 | 5 |
| Balance .. | 1 | 4 | 5 | 3 | 17 | 5 | 3 | 14 | 1 |
| Balance per head .. | | 8 | 2 | | 19 | 4 | 1 | 4 | 8 |

In the above account nothing has been charged either for litter or attendance.

*Summary.*

Too much importance must not be attached to these results, obtained as they were with a small number of animals in each lot. The object in view was two-fold ; on the one hand it served the purpose of familiarising students with the Galloway breed as beef animals, and it provided an opportunity for general demonstration purposes in stock judging; while from the experimental point of view it took a secondary place, although every care and precaution was exercised to make the test accurate and reliable.

The following results may, however, be referred to

(1) The Molascuit Cattle did better than the root fed animals. This reverses the results obtained from last year's experiment ; when the root beast did rather better than those

receiving molascuit. Bearing in mind the small number of animals used, the results of both years would indicate that molascuit may reasonably be used to replace roots for fattening bullocks, in the proportion of 1 lb. of molascuit to 14 lbs. of roots, where molascuit is quoted somewhere about £5 per ton, and when roots are valued on the farm at 7s. 6d. per ton. Where the price of the latter is higher than this (as when they may not be grown on the farm, but have to be purchased at market price), then molascuit would appear a decidedly cheaper substitute for roots.

(2) The extra cake bullocks did best, although the daily allowance did not exceed 8 lbs. as against 4 lbs. in the other two lots. At the same time it should be noticed that bullock No. 10 made an exceptionally high daily gain —3.01 lbs. ; in fact, more than double that of either of the other two bullocks in the same lot. Also if reference be made to the daily gains put on by the molascuit-fed beasts, it will be seen that each bullock of this lot made a higher average daily gain than any bullock in Lot. III., with the exception of the above-named bullock.

(3) There appears to be little difference between the animals tied in stalls and those running loose in a covered yard, as far as rate of increase in live weight is concerned, and this corroborates the results obtained at Woburn, and also at various experimental stations in America.

In conclusion, our thanks are due to Mr. Keable, who rendered valuable assistance by undertaking the feeding of the bullocks during the Christmas vacation.

# PIG FEEDING EXPERIMENTS.

B. N. WALE, B.Sc.

The pig-feeding experiments carried out during the past season had for their objects :—

(1) The comparison of English and Foreign Barley as a food for pork production.

(2). The value of coal slack as an adjunct to the diet of fattening pigs.

1. *Summary.*—The foreign barley gave a rather better return than the English barley for pork production, on the average .25 lbs. less of the foreign barley being required for each 1 lb. gain in live weight. This corrobates the results obtained on the College farm during the winter of 1906-7, and reported on in the *Journal* for 1907. That report shows that .27 lbs. less of the foreign barley was required for 1 lb. live weight gain. It seems safe to conclude, therefore, that foreign barley possesses a rather better pork producing value than English barley. Consequently it may be recommended when its price is either below, or equivalent to, that of English grinding barley.

2. Coal slack has given a decided advantage when fed along with the meal as compared with feeding meal without it. Lots II. and III. in both experiments, which are comparable for this purpose, show an increased profit per head for the coal slack of 2s. 2¼d. and 1s. 7½d. respectively, or an average on the nine pigs of 1s. 10¾d. per head.

The price of 25s. per ton for coal slack is a high one, and probably less than half this value would be sufficient to cover cost and carriage in districts situated near the pit mouth. But the cost per pig even at the higher price is quite a small one, being on the average only about 9d. per 100 lbs. live weight gain, so that the total cost of the coal slack will not very appreciably affect the result.

The quantity of slack consumed per pig per week was 2.94 lbs. in Experiment A, and 3.53 lbs. in Experiment B, and as the smaller amount gave the better result, it would appear as if 3 lbs. per head per week for porkers should not be exceeded. Further experiment, however, is desirable for determining the most profitable quantity to feed.

In a state of nature, pigs in search of animal and vegetable food consume a large amount of soil, etc, whereas under domestication, when kept on paved floors, there is little chance of them obtaining this, hence coal would appear to be a good substitute.

# BREEDING FROM EWES AT AN EARLY AGE.

B. N. Wale, B.Sc.

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The object of this experiment is to ascertain to what extent breeding from ewe tegs (*i.e.*, tupping at seven months of age instead of at one year seven months) may be carried on without appreciably reducing the size, vigour, and constitution of the ewes.

Fifty Border Leicester × Cheviot or Half-bred ewe tegs were purchased for the purpose at Hawick, in September, 1908.

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To the Northerner "Halfbreds" are well known, but it may be as well to give their chief points for the benefit of those who may not be acquainted with the breed.

The Halfbred may be produced in one of two ways; either (1) by using a Border Leicester ram on a Cheviot ewe, or (2) by mating together the progeny of (1), *i.e.*, by using a Halfbred ram on a Halfbred ewe.

There appears to be little difference which method is adopted, the offspring from (2) being as true as those from (1).

Halfbreds show a distinct Cheviot type, *viz.*: clean faces, covered with white hair, Roman noses, ears erect and mobile, with a slight inclination forwards, clean white legs; the body being covered with demi-lustre wool, long in the staple and closer than in the Border Leicester.

These sheep in South Scotland and the North of England are much sought after for feeding on turnips and are also used for the production of fat lamb.

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The fifty ewe tegs were individually weighed and tattooed with a distinguishing number in the right ear on October 28th, 1908.

They were divided into two lots, the weights and numbers being as given in the table following.

A Southdown ram lamb was mated to the Halfbreds of Lot 1, early in November, and this ram was substituted for another a month later.

Of the twenty-five thus mated eighteen gave birth to nineteen lambs, one of which died soon after birth, and seven proved barren.

The tegs of Lots 1 and 2 were wintered on grass with the assistance of a few roots, and hay, and were treated exactly alike until a fortnight before lambing, when the in-lamb lot received more nutritious food.

Of the eighteen in-lamb ewes there was not a single case of difficult parturition. This may possibly be accounted for in two ways :—

1—The small type of ram (Southdown) used.

2—The naturally narrow head of the Halfbred—a feature inherited by its offspring.

Two of the eighteen tegs had twin lambs, and one of these tegs produced insufficient milk to rear both lambs. With this exception the ewes proved good mothers and their lambs have done well.

The figures show, therefore, that in producing and rearing a lamb, each ewe was dwarfed to the extent of seventeen pounds live weight. This live weight cannot be valued at more than fourpence per pound, looked at from the butcher's point of view, and considering present prices.

17 lbs. at 4d.=5s. 8d.

Each lamb, therefore, was produced at a loss of 5s. 8d. on the ewe, and was thus cheaply obtained.

The ewes are being kept on ; both lots were put to ram last autumn, and weights will again be taken when the sheep are two years eight months of age, after which a further report will be made. (For Table see page 30.)

A note of explanation should be given for removing those sheep marked with a .* In Lot I., the reason of this is fairly obvious, *viz.* : those which proved barren and the ewe (No. 3) which lost her lamb a few days after birth. The reason for the removing of No. 23 is given below. In Lot II. those sheep are removed which correspond with those removed from Lot I., as far as the original

| Lot I. put to Ram. | | | | | Lot II. not put to Ram. | | | | |
|---|---|---|---|---|---|---|---|---|---|
| No. of Sheep. | Remarks. | Live Weight in lbs. at 8 months. | Live Weight in lbs. at 1 year 8 months. | Gain in lbs. Live Weight. | No. of Sheep. | Remarks. | Live Weight in lbs. at 8 months. | Live Weight in lbs. at 1 year 8 months. | Gain in lbs. Live Weight. |
| 30 | Reared one lamb | 82 | 110 | 28 | 48 | | 84 | 139 | 55 |
| 6 | Reared one lamb | 80 | 112 | 32 | 35 | | 83 | 132 | 49 |
| 8 | Reared one lamb | 79 | 90 | 11 | 49 | | 79 | 136 | 57 |
| 2 | Reared one lamb | 78 | 112 | 34 | 37 | | 78 | 118 | 40 |
| *39 | Barren | 77 | 127 | 50 | *9 | | 77 | 137 | 60 |
| *26 | Barren | 76 | 132 | 56 | 41 | | 77 | 124 | 57 |
| 1 | Reared one lamb | 75 | 116 | 41 | *16 | died at 10 mos. | 75 | | |
| 40 | Reared one lamb | 75 | 115 | 40 | 34 | | 74 | 124 | 50 |
| *15 | Barren | 74 | 128 | 54 | *42 | | 73 | 121 | 48 |
| *19 | Barren | 73 | 136 | 63 | 25 | | 72 | 124 | 52 |
| 11 | Reared one lamb | 71 | 112 | 41 | 18 | | 71 | 122 | 51 |
| 21 | Reared one lamb | 71 | 111 | 40 | *14 | died at 11 mos. | 71 | | |
| *29 | Barren | 70 | 109 | 39 | *32 | | 70 | 116 | 46 |
| 31 | Reared one lamb | 70 | 92 | 22 | 43 | | 70 | 121 | 51 |
| 22 | Reared one lamb | 69 | 108 | 39 | 13 | | 69 | 124 | 55 |
| *3 | Produced a lamb which died a few days after birth | 69 | 109 | 40 | *20 | | 69 | 126 | 57 |
| 10 | Reared one lamb | 69 | 107 | 38 | 17 | | 68 | 131 | 63 |
| 12 | Reared one lamb | 68 | 102 | 34 | 45 | | 68 | 113 | 45 |
| 28 | Reared one lamb | 67 | 103 | 36 | 7 | | 67 | 120 | 53 |
| 5 | Reared one lamb | 66 | 106 | 40 | 36 | | 67 | 109 | 42 |
| *33 | Barren | 65 | 91 | 26 | *47 | | 65 | 122 | 57 |
| 27 | Reared *two* lambs | 64 | 97 | 33 | 38 | | 64 | 109 | 45 |
| * 4 | Barren | 64 | 112 | 48 | 46 | | 63 | 114 | 51 |
| 44 | Reared one lamb | 63 | 99 | 36 | *24 | died at 10 mos. | 62 | | |
| *23 | Reared one lamb | 60 | 88 | 28 | *50 | | 57 | 136 | 79 |
| | Total gain in live weight | | | 949 | | | | | 1163 |
| | Deduct gains from 9 sheep marked * | | | 404 | | | | | 347 |
| | Hence 16 sheep gained | | | 545 | | | | | 816 |
| | Average gain per sheep | | | 34 | | | | | 51 |

live weights are concerned. and obviously also, those which died during the progress of the experiment. No. 50 is removed because this teg had been kept in quarantine owing to a bad attack of foot-rot at the time of purchase, and thus when first weighed she had become considerably emaciated, and consequently showed a low live weight, hence this extra lean condition was the cause of her putting on such a large live weight increase during the year. The only sheep in Lot I. approximately approaching No. 50 in live weight was No 23, and although this had produced a lamb it was thought a more reliable result would be obtained by omitting her from the calculation altogether.

# THE FINANCIAL ASPECT OF SHEEP-WASHING.*

By B. N. Wale, B.Sc.

Lecturer in Agriculture, South-Eastern Agricultural College, Wye.

The desirability of washing sheep before shearing is a question on which the greatest divergence of opinion exists, and the average farmer, after reading through the literature of the subject in the agricultural publications of the last fifty years, would probably be as dubious about the matter as he was before. It may be instructive, therefore, in the first place, to recapitulate some of the more striking statements which have been made.

*The History of the Subject during the last Half-century.*—In the Royal Agricultural Society's Journal of 1855, John Wilson, late Professor of Agriculture, Edinburgh University, in an article on the "Various Breeds of Sheep in Great Britain with Special Reference to Wool," states (page 245): "It is the custom of the farmers in Devon not to wash the sheep before shearing them, and the wool being thus in the yolk or grease, is not so marketable as other kinds which are washed. . . . If the wool were washed and shown in the same way as in other districts, it would be readily saleable." It would thus seem that the practice of not washing was then getting a foothold in Devon, while in the remainder of the kingdom the custom was to wash, even Scotch Blackfaced being quoted for washed wool in the article just referred to.

Twenty years later, in the same Society's Journal for 1875, in an article by Earl Cathcart on "Wool in Relation to Science with Practice," the following statement is made (p. 343): "It is quite true a great portion of the wool grown in Devon, Somerset, and Cornwall is sold in the grease, not having been washed on the sheep's back, and there is great difference of opinion amongst farmers about it. The buyers prefer it well washed, and it is more marketable: in consequence washing is becoming more general. . . . The United States Agricultural Reports testify strongly to the same effect, viz., that wool should not be clipped in the grease, but well washed on the sheep's back." Earl Cathcart's article also includes a letter (pp. 346-7) from the Secretary of the Bradford Chamber of Commerce, wherein washing is strongly recommended by the Committee of that body.

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* Reprinted from *The Journal of the Board of Agriculture.*

The next mention of washing sheep is found in the Royal Agricultural Society's Journal of 1878. In an article on "Practical Agriculture," chap. iv., by John Algernon Clarke (pp. 524-5), the writer states that "Sheep washing before clip day, though generally conducted in a primitive manner, has received greater attention of late years." Various methods of washing are next described, and the conclusion arrived at is that "as much as 2s. per tod (28 lb.) being the difference in value between well cleansed and badly washed wool, this extra carefulness in the process is found to pay." Note that the difference in price mentioned approximately equals 1d. per lb., and further, that this represents the difference in value between well and badly washed wool, and not between washed and unwashed, which would be much greater.

Ten years later, 1888, J. W. Turner, of Bradford, has an article in the same Journal on "Wool and its Uses," in which washing is recommended and described, and a reference is made to Earl Cathcart's paper of 1875 to correct an error made by that writer as to the injury done by using soft soap when washing sheep, and advocating the use of cold water only.

In the same Society's Journal of 1893, J. E. Hargreaves, writing from Kendal, Westmorland, has an article on "Sheep-washing," wherein the opinion is expressed that washing sheep before shearing is a waste of time and labour, and as the writer is a wool salesman of some thirty years' experience, his dictum must have greatly assisted in bringing into fashion the method of marketing wool in the unwashed condition. He states: "If it is on account of the wool (that washing is done), I hope to be able to show that farmers are incurring an annual expenditure and giving themselves needless trouble, which in these bad times might be avoided. . . . My experience . . . is that unwashed British wool finds a readier market to-day than the washed wool. I have before me the views of several North Country farmers who have carefully tested the matter, and in every case, except one, the result to the grower has been advantageous. . . . If I was a farmer with clean grass land, I would never wash a sheep again." This opinion of Mr. Hargreaves will be referred to later.

Seven years afterwards, in 1900, the Journal of the sister Society—the Highland and Agricultural Society of Scotland—contains an article on "Wool Growing and Wool Showing," by Professor John Scott, Edinburgh, wherein the writer advocates the earlier view that "sheep should be properly washed before shearing. With coarse, low-priced wools like the Scotch Blackfaced, it is different. They are chiefly used in carpet manufacture, and as colour is not so important there is less difference in the price of washed and unwashed in their case, than in the finer breeds of wool. But there is another good commercial reason why Scotch Blackfaced wool is not washed. Large quantities of it are exported to America, where carpet wools are admitted at a duty of 2½ cents on wool costing less than 6d. per lb., and 5 cents on wool costing more than 6d. per lb. . . . All other sorts (of wool) exported to America are charged 10 cents per lb. duty, washed or unwashed, hence buyers who have 5d. per lb. duty to pay will pay it on wool and not on dirt."

There is here a new argument for washing in the case of the finer wools, viz., the duty the American buyer (and he is a very important buyer) has to pay for weight of material whether made up of wool or dirt.

Returning once more to the Royal Agricultural Society's Journal. In 1902, there was an article on "The Production of British Wool," by Jonas M. Webb, where (p. 413) the following note on washing is found: "The warmly debated question whether wool should be sold washed or unwashed is often raised among flockmasters, for if the wool is washed weight is lost, but an increased price per lb. is realised." The conclusion of a breeder was that "in a season when there is a good deal of yolk in the wool it is better for the farmer to sell his wool unwashed; but that in a season in which such yolk is deficient it may pay him to wash his flock."

Coming now to the *Journal of the Board of Agriculture*, and taking into account the shorter period of time during which this publication has been issued, a much greater constancy in advocating washing prior to shearing is found. Vol. VIII., June, 1901, contains an article on "The Handling of British Wool for Market," by J. W. Turner, who states (p. 7): "It is probable, however, that the practice of leaving sheep unwashed may have given rise to some slipshod handling of wool in the past few years. It would be an unfortunate circumstance if the British wool-grower should, at a moment when competition is keenest, depart from the honoured practices of his prececessors, on the ground that there has been a fall in prices. . . . The argument that because prices are low the article ought to be neglected and less care given to it, is sufficient to produce a feeling of despair in the minds of those who are interested in the wool trade." Again (p. 10): "Sheep should be washed in cold water without any soap."

In the *Journal of the Board of Agriculture* for 1907, Vol. XIV., there are two articles which contain references to washing:—

(1) In "The Preparation of Wool for Market" (p. 96), it is stated that the need for greater care in preparing wool for market was emphasised at a meeting of the Home Wool Buyers' Association, held at Bradford in April, 1907. The Chairman of this meeting is reported to have said that "It was to the interests of the grower to have his wool got up for the market in the best possible shape. By this he meant it should be washed in the best style practicable, that it should be properly cleaned, have all the dockings clipped off the fleeces, and be kept as free from straws and sticks as possible. . . . Many farmers in getting up their wool seemed to be under the impression that they would get as much for it if it was prepared for the market in a slovenly manner, as they could by getting it up in a workmanlike and careful style. This was a mistake, as farmers' wool would always command a price commensurate with its condition and cleanness. . . . There were many classes of our home-grown wools which Americans could not buy because of the slovenly way in which they were sent to the market."

(2) " Preparation of Wool for Market " (p. 241). The Home Wool Buyers' Association have issued suggestions to wool-growers, among which is found : " Washing—Sheep to be carefully washed and clipped within ten or twelve days after washing, otherwise the wool cannot fairly be sold as washed. Sheep should be properly dagged before washing, as the manure not only discolours the water, but damages the fleece."

The most up-to-date and comprehensive view as to the continuance or abandonment of the practice of washing in the different districts of Great Britain is to be found in a " Report on the Production of Wool in Great Britain in 1905 and 1906," by Mr. R. H. Rew, published by the Board of Agriculture and Fisheries. This report ought to be in the hands of all flockmasters, as much valuable information is given in it. From that report it is possible to arrange Great Britain into three well-defined areas, where : (*a*) " Washing is generally practised " ; (*b*) " About half the wool is washed " ; (*c*) " Washing little done or not at all."

(*a*) *Washing Generally Practised.*—This district in England lies north of a line drawn from Bristol to Norwich, and includes the whole of the middle of England and the North with the exception of Northumberland, where a large number of Blackfaced sheep are found which are unwashed. The whole of Wales also falls under (*a*).

(*b*) *About half the Wool Washed.*—The area where this description holds good extends on either side of a line drawn in a somewhat south-westerly direction from Ipswich in Suffolk to Wellington in Somerset, and includes the counties of Suffolk, Essex, Herts, Bucks, Middlesex, Oxford, Berks, Wilts, Hants, and Somerset.

(*c*) *Washing little done or not at all.*—This includes two small districts—the extreme S.W., viz., Devon and Cornwall, and the County of Surrey.

Now, on reference to a geological map, it will be seen that a large portion of the districts (*b*) and (*c*) lies on the Chalk, and the paucity of water on this formation, and its extreme hardness where found, provides one likely reason why washing is so little practised, as indeed was explained to the writer in the case of Surrey. It will not, however, explain why washing is so little practised in Devon and Cornwall. In the report above referred to, washing is specifically described as becoming a decreasing practice in the counties of Cambridge, Herts, Norfolk, and Oxford.

In Scotland practically the opposite is the case to what was found in England. With the exception of a district in the South, bounded by a line running parallel to the Border, and some twenty or thirty miles from it, and another small district in the extreme North, including Caithness, Sutherlandshire, Ross and Cromarty, the great bulk of Scotland shears its sheep in the unwashed condition.

The districts where (*a*) " Washing is Generally Practised " are two—the extreme North—Caithness and Sutherlandshire, and in the South, Berwick and Dumfries (except Blackfaced sheep), while (*b*) where " About half the wool is washed " includes districts bordering on the two mentioned under (*a*), viz., Ross and Cromarty in the North, and Haddington, Roxburgh, and Kirkcudbright in the South.

The same report places the percentage of unwashed wool in the total clip for Great Britain at 28 per cent., *i.e.*, 952,000 fleeces unwashed, out of a total of 3,348,000 fleeces, but it adds that "the general impression given by an examination of the growers' returns would suggest that the proportion of unwashed wool is larger than is thus indicated. There is evidence of a tendency in recent years to discontinue the practice of washing."

In the *Agricultural Gazette* published as recently as last summer (1908) there was an editorial article on " Sheep Washing," from which the following is taken. " Not many years ago ' unwashed ' was an exceptional description of lots on sale catalogues, but in some districts this is more true of washed wool. Some pertinent reasons for abandoning the time-honoured . . . pastoral operation of washing sheep have been placed before flockmasters, and accepted by most of them as conclusive."

The disadvantages of washing, given in the article above referred to, will be dealt with later. The statement contained in the concluding part of the last sentence appears, however, much too drastic in the light of the figures just quoted from Mr. Rew's report.

*Recent Wool Sales.*—Sufficient references, portraying much diversity of opinion, have been given to show that flockmasters may well be very doubtful as to the advantages of washing sheep. It was on this account that the writer, after attending the annual Wool Sale held at Guildford last July, set about gleaning information which should give a decisive answer to this much-debated question. Owing to the courtesy of Mr. Fred Lee, of Messrs. Hewett and Lee, of Guildford, whose assistance in connection with all the figures in this article the writer gratefully acknowledges, the weight of each lot of wool was obtained, the prices per lb. being secured at the time of sale, and corroborated later by reference to Messrs. Hewett & Lee's books. The Catalogue of Sale contained a detailed account of the number of fleeces, whether washed or unwashed, and the age, sex, and breed of sheep from which the different lots of wool were clipped. By means of these data the total number of fleeces, say, of washed wool of any particular class of sheep, and their weight were arrived at. By dividing the total number of lbs. of this wool by the number of fleeces, the average weight of each washed fleece was obtained. This weight, multiplied by the average price realised, gave the average value of the washed fleece. Similarly the average value of the unwashed fleece was got at. In this way the value of the fleece (or per head of sheep) for several breeds and ages of sheep which were represented at Guildford, was estimated. These figures are shown in Table I. Where the description in the Catalogue of any lot of wool appeared to be inadequate, or where mixed wools were put up in one lot, the figures have been discarded altogether so as to eliminate possible errors arising from these sources.

Table I, p. 39, shows that by washing sheep before shearing an increase of from 5d. to 11½d. per fleece was obtained, or an average of 7¾d. per fleece over the whole sale of some 9,000 fleeces, representing over 50,000 lb. of wool. In addition to the breeds above enumerated, wool from Devons, Mashams, Suffolks, Cheviots, and Dorsets was also on sale at Guildford, but in insufficient quantity to classify it into washed and unwashed lots. The statistics given are based on approximately 75 per cent. of the total wool offered at this particular sale. The very high increased value for washing, indicated by the figures shown above, suggested that 1908 might have been an exceptional year, and bearing in mind one of the commoner excuses for not washing sheep, viz., " because it doesn't

## TABLE I.—YEAR 1908.

| Breed, Age, and Sex of Sheep. | | Washed or Unwashed. | Number of Fleeces. | Total lbs. of Wool. | Lbs. per Fleece. | Price per lb. | Value per Fleece. | Increased Value per Fleece for Washing. |
|---|---|---|---|---|---|---|---|---|
| | | | | | | d. | d. | d. |
| Southdowns : | Ewes .. | Washed | 2,114 | 8,833 | 4.17 | 10.40 | 43.36 | 5.95 |
| | ,, .. | Unwashed | 2,048 | 10,752 | 5.16 | 7.25 | 37.41 | |
| | Tegs .. | Washed | 521 | 2,834 | 5.43 | 10.50 | 57.01 | 11.59 |
| | ,, | Unwashed | 1,648 | 11,200 | 6.79 | 6.69 | 45.42 | |
| Hampshires : | Ewes .. | Washed | 58 | 320 | 5.51 | 8.50 | 46.83 | 9.72 |
| | ,, .. | Unwashed | 431 | 2,544 | 5.90 | 6.29 | 37.11 | |
| Kents : | Ewes .. | Washed | 520 | 3,122 | 6.00 | 7.33 | 43.98 | 10.86 |
| | ,, .. | Unwashed | 89 | 576 | 6.47 | 5.12 | 33.12 | |
| Exmoors : | Ewes .. | Washed | 25 | 100 | 4.00 | 10.00 | 40.00 | 6.21 |
| | ,, | Unwashed | 325 | 2,081 | 6.40 | 5.28 | 33.79 | |
| Scotch : | Ewes and Tegs | Washed | 567 | 3,312 | 5.84 | 5.75 | 33.58 | 6.21 |
| | ,, ,, | Unwashed | 153 | 986 | 6.44 | 4.25 | 27.37 | |
| Crossbreds : | Ewes .. | Washed | 190 | 979 | 5.15 | 8.12 | 41.81 | 5.13 |
| | ,, .. | Unwashed | 402 | 3,061 | 7.61 | 4.82 | 36.68 | |
| Totals | .. .. | .. | 9,091 | 50,520 | | | | |
| Average | .. .. | .. | .. | .. | .. | .. | .. | 7.81 |

## TABLE II.—YEAR 1901.

| Breed, Age, and Sex of Sheep. | Washed or Unwashed. | Number of Fleeces. | Total lbs. of Wool. | Lbs. per Fleece. | Price per lb. | Value per Fleece. | Increased Value per Fleece for Washing. |
|---|---|---|---|---|---|---|---|
| | | | | | d. | d. | d. |
| Southdowns : Ewes .. | Washed | 1,945 | 7,706 | 3.96 | 7.72 | 30.57 | 3.45 |
| ,, .. | Unwashed | 1,783 | 11,632 | 6.52 | 4.16 | 27.12 | |
| Tegs .. | Washed | 307 | 1,765 | 5.74 | 7.66 | 43.96 | 16.73 |
| ,, .. | Unwashed | 729 | 5,337 | 7.32 | 3.72 | 27.23 | |
| Hampshires : Tegs .. | Washed | 87 | 473 | 5.43 | 6.50 | 35.29 | 3.39 |
| ,, .. | Unwashed | 369 | 3,074 | 8.33 | 3.83 | 31.90 | |
| Crossbreeds : Ewes .. | Washed | 212 | 1,261 | 5.94 | 6.00 | 35.64 | 6.27 |
| ,, .. | Unwashed | 1,457 | 11,073 | 7.59 | 3.87 | 29.37 | |
| Tegs | Washed | 290 | 1,680 | 5.79 | 5.50 | 31.84 | 4.40 |
| ,, .. | Unwashed | 232 | 1,629 | 7.02 | 3.91 | 27.44 | |
| Totals .. | .. | 7,411 | 45,630 | | | | |
| Average .. | .. | .. | .. | .. | .. | .. | 6.85 |

## TABLE III.—YEAR 1904.

| Breed, Age, and Sex of Sheep. | Washed or Unwashed. | Number of Fleeces. | Total lbs. of Wool. | Lbs. per Fleece. | Price per lb. | Value per Fleece. | Increased Value per Fleece for washing. |
|---|---|---|---|---|---|---|---|
| | | | | | d. | d. | d. |
| Southdowns : Ewes . . | Washed | 2,067 | 9,002 | 4.35 | 11.06 | 48.11 | 0 |
| ,, . . | Unwashed | 1,757 | 10,548 | 6.00 | 8.02 | 48.12 | |
| Tegs . . | Washed | 391 | 2,096 | 5.36 | 11.41 | 61.15 | 4.27 |
| ,, . . | Unwashed | 762 | 5,371 | 7.14 | 8.08 | 56.88 | |
| Hampshires : Ewes . . | Washed | 91 | 509 | 5.59 | 10.62 | 59.36 | 4.10 |
| ,, . . | Unwashed | 346 | 2,436 | 7.04 | 7.85 | 55.26 | |
| Crossbreeds : Ewes . . | Washed | 53 | 334 | 6.30 | 9.50 | 59.85 | 1.13 |
| ,, . . | Unwashed | 52 | 382 | 7.34 | 8.00 | 58.72 | |
| Totals . . | . . | 5,519 | 30,678 | | | | |
| Average . . | — | . . | . . | . . | . . | . . | 2.37 |

## TABLE IV.—SUMMARY OF YEARS 1901, 1904, AND 1908.

| Breed, Age, and Sex of Sheep. | | Number of Fleeces Washed. | Number of Fleeces Unwashed. |
|---|---|---|---|
| Southdowns : | Ewes | 6,126 | 5,628 |
| | Tegs | 1,219 | 3,189 |
| Hampshires : | Ewes | 149 | 777 |
| | Tegs | 87 | 640 |
| Kents : | Ewes | 520 | 201 |
| | Tegs | 339 | 0 |
| Exmoors : | Ewes and Tegs | 25 | 534 |
| Scotch : | ,, ,, | 567 | 470 |
| Crossbreeds : | Ewes | 586 | 2,113 |
| | Tegs | 290 | 633 |
| Devons : | ,, | 0 | 106 |
| Mashams : | ,, | 129 | 0 |
| Cheviots : | Ewes | 80 | 0 |
| Suffolks : | Tegs | 17 | 301 |
| Dorsets | | 184 | 71 |
| Spanish | | 0 | 27 |
| Totals | | 10,318 | 14,690 |
| | | 25,008 | |

pay when wool is low in price," it was resolved to investigate prices made when wool was almost at its lowest in recent years, and for this purpose the year 1901 was selected, although it was subsequently found that during the following year—1902—wool touched its lowest, being about ¼d. per lb. cheaper than in 1901. Again, the figures for the year 1904 were also investigated, as in that year prices ruled very similarly to those of the year 1908.

Table II, p. 40, shows that in the year 1901 there were nearly 7,500 fleeces, representing 45,000 lb. of wool, on which the statistics are based, and the advantage of washing works out at 6¾d. per fleece. The figures indicate a greater variation than those of 1908, in that the advantage for washing ranges from 3⅓d. to 1s. 4¾d. per fleece.

Besides the breeds mentioned in Table II., those in Table III. were represented, but only either in the washed or the unwashed condition, and not in both; Devons, Suffolks, Dorsets, Kents, Scotch, Exmoors, and Spanish.

In addition to the foregoing the other breeds represented, but with washed or unwashed wool only, were Scotch and Exmoors.

As far as numbers are concerned, the year 1904 (a high-priced year) is the least satisfactory, there being 5,500 fleeces against 7,500 in 1901, and 9,000 in 1908. This is still better shown by reference to the total weight of wool, of which there were 30,000 lb. in 1904, 45,000 lb. in 1901, and 50,000 lb. in 1908. This year shows the smallest difference in value between the washed and unwashed fleece, though even here it is considerable on the average, viz., 2⅓d. higher for the washed fleece.

Strange to say, at the 1904 sale, the value of the washed and unwashed fleeces from the Southdown ewes was approximately the same—just over 4s. These figures, however, are to be relied on, for on reference to the prices per lb. given for the separate lots, the extreme limits of variation are very small, being only from 10½d. to 11¾d. per lb. in the case of the washed wool, and only from 7½d. to 8¾d. for the unwashed. It is, however, a very exceptional case, for out of the sixteen examples given in the three tables above, and taken indiscriminately from any three years, this is the only one which shows no advantage for washing.

Grouping together the increased values obtained during the three years, an average increased value of 5.67d. per fleece for washing, is obtained. (See Table VI.)

In Table No. IV., p. 42, the total numbers of washed and unwashed fleeces of the different breeds are given for the three years. These figures are larger than the figures given in Tables I., II., and III., because lots of wool which were either washed only or unwashed only are included.

From that table it will be seen that over 58 per cent. of the sheep in the Guildford district are shorn in the unwashed condition.

There are a large number of factors influencing the amount of loss in weight a fleece undergoes by washing, the principal one being, not the grease, but the amount of dirt contained in the wool; this will naturally be greater in the case of the long-woolled breeds than in the short-woolled ones, and very much greater where sheep are folded on arable land in dirty weather than where the natural lair is a clean pasture.

The actual loss per cent. due to washing is shown in Table V., p. 45. The shrinkages show very great variations, but the average is one which is generally accepted, viz., 20—25 per cent.

It would appear that the buyer having found out by previous experience how enormous the variation is, takes good care to safeguard himself when he is dealing with unwashed wool.

*Objections to Washing.*—The objections generally raised against washing sheep are:—(1) The cost. (2) Damage done to nursing ewes, fat sheep, and sheep in very low condition in the way of contracting chills, which may result fatally; and occasional cases of drowning. (3) When prices are low the difference between washed and unwashed wool is not considered sufficient to pay for the trouble and risk involved. (4) Common wash pools are undesirable because of the liability of sheep being exposed to infection by such diseases as scab and foot-rot.

*Financial Aspect of Washing.*—(1) *The Actual Cost.*—This works out in average cases to a very small figure per head, and probably rarely exceeds ½d. per sheep. The estimates of two practical farmers, one from Kent and one from Leicestershire, are given below. They have both placed the number of sheep washed per day low, so as not to under-estimate the cost. The Kent

### TABLE V.

| Breed, Age, and Sex of Sheep. | | | Percentage Loss in Weight by Washing. | | | |
|---|---|---|---|---|---|---|
| | | | 1901. | 1904. | 1908. | Average. |
| Southdowns : | Ewes | .. | 39.27 | 27.50 | 19.19 | 28.65 |
| | Tegs | .. | 21.59 | 23.87 | 20.03 | 21.83 |
| Hampshires : | Ewes | .. | — | 20.60 | 6.62 | 13.61 |
| | Tegs | .. | 34.82 | — | — | 34.82 |
| Kents : | Ewes | | — | — | 7.27 | 7.27 |
| Exmoors : | ,, | .. | — | — | 37.50 | 37.50 |
| Scotch : | ,, | .. | — | — | 9.32 | 9.32 |
| Crossbreds : | ,, | .. | 21.74 | 14.17 | 32.33 | 22.74 |
| | Tegs | .. | 17.95 | — | — | 17.95 |
| Average | | .. | .. | .. | .. | 21.52 |

example shows 400 sheep washed per day by three men :—Shepherd at 3s. ; two labourers at 2s. 9d.=5s. 6d. ; total, 8s. 6d.

There is also a charge of 1d. per score for the use of the tun (the circular bricked bath found on several farms in most parishes in the district) ; but this charge would not apply where the flock-master had his own tun ; however, perhaps a small sum should be charged in such a case for interest and repairs. One penny per score=1s. 8d. on the 400 sheep. This added to 8s. 6d. gives 10s. 1d. as the total cost of washing 400 sheep, which works out to 0.30d. (*i.e.* approximately ⅓d.) per head.

The Midland example takes 550 sheep washed as a day's work, and it must be remembered that here the bath is generally larger—formed by damming up a stream, or using part of a pond—hence more sheep can be " in soak " at one time, and they consequently require less time in the shepherd's hands ; but these 550 sheep require four attendants instead of three, as in the previous case. Shepherd, at 3s. ; two labourers at 2s. 9d.=5s. 6d. ; one youth at 2s. ; total, 10s. 6d. Threepence per score for use of wash-place, if not on the farm, is sometimes charged when there is a common wash for one or more parishes. This, on 550 sheep= 6s. 10½d.—making a total of 17s. 4½d., which works out to 0.37 pence, or just over ⅓d. penny per head.

The figures given in the above two examples, representing the number of sheep washed per day, may be rather low where washing is done on the farm, but they allow for time taken up in driving the sheep to and from the wash-place, situated perhaps a mile or more away.

(2) *Damage done to Sheep, sometimes with fatal results.*—Men who make a practice of carefully washing their sheep year by year state that loss under this head is very small.

In case of nursing ewes, care should of course be taken not to wash with prevailing east winds ; sheep should be fasted several hours before washing ; they should not be overdriven either to or from the wash-place. With regard to cases of drowning this would generally be regarded by practical men as due to gross carelessness on the part of the men in charge.

In discussing the objections under this head with flock-masters, the consensus of opinion seems to place such loss altogether at about one sheep out of 500.

Putting the average value of this sheep at the rather high figure of 50s. (for the sheep likely to be lost from this cause would probably be a weakly one), the loss on this score works out to 1.2d. per head. This will bring the total cost under (1) and (2) to 1.5d. Hence 1½d. per head of the flock will cover cost and risk.

(3) *Whether it pays to wash when prices are low.*—This has been fully worked out in the case of the low-priced year of 1901 (Table II.), for one locality, viz., Guildford. The average increased value of fleece for washing during this year was 6.85d. Deducting from this the costs and risk 1.5d., there is left a profit of 5.35d. per fleece, which on a flock of 500 sheep means a sum of £11 2s. 11d. as the total profit, or £6 13s. 9d. on a flock of 300.

It is interesting to notice in this connection that washing paid the farmer considerably better in the low-priced year of 1901 than in the high-priced year of 1904.

(4) *Liability of flocks to contract contagious diseases at common wash-pools.*—The risk in the case of scab is not very great, considering the restrictions in force in an infected area, and in the case of there being no wash-place on the farm, the probability is that with scab prevailing at shearing time, such flock would then have to be shorn in the unwashed condition. With foot-rot the case is not so free from danger, but by walking the sheep over freshly slaked lime, or through a bluestone trough on their return from the wash, the risk from this cause would be reduced to a minimum.

*The Advantages of Washing.*—These are several, and placed in the order of importance are :—

(1) *Increased Value obtained per fleece.*—This often leaves a very substantial profit. It has already been shown what this amounted to for a flock of 500 sheep in 1901. But a fairer result is obtained by taking the averages of the three years investigated as shown in Table VI. below.

TABLE VI.

| Year. | Increased Value (in pence) per Fleece by Washing. | Profit (in pence) per Fleece, after deducting cost and risk at 1½d. per head. |
|---|---|---|
| 1901 .. .. | 6.85 | 5.35 |
| 1904 .. .. | 2.37 | 0.87 |
| 1908 .. .. | 7.81 | 6.31 |
| Average .. .. | 5.67 | 4.17 |

The average profit per fleece is thus found to be 4.17d. per head, and 4.17d. per head on a flock of 500 sheep results in a total profit of £8 13s. 9d., or of £5 4s. 3d. on a flock of 300 sheep. In the case of the year 1908, the profit per head of 6.31d. works out to no less a sum than £13 2s. 11d. on a flock of 500, or £7 17s. 9d. on 300.

If a selection be made of special classes of sheep as, *e.g.*, Southdown tegs (Table I.), it is seen that the profit in this case would be considerably higher, viz., £24 2s. 11d. for a flock of 500 sheep, or £14 9s. 9d. for one of 300.

With such favourable results there should be little hesitancy in washing sheep, and farmers will reap the benefit of renewing the practice of washing where it has been abandoned. Nor need those farmers who have never relinquished the practice of washing fear that if washing becomes general the price of wool will come down, for the clip of the British Isles supplies little more than one-fourth (viz., 27 per cent.) of the total home consumption, which for the year 1906 was approximately 493,000,000 lbs., while our home sheep produced 133,000,000 lbs. only.

(2) *Wool, when washed, is more attractive to the buyer.*—In other words, competition for it is keener ; this was very noticeable at the Guildford sale last year, for when specially clean lots were put up there was much more spirited bidding.

As in any business, the man who makes his wares the most attractive commands the readiest sale for them. The Canadian system of grading fruit for market, whereby uniformly even and clean fruit has displaced to a considerable extent home-grown, carelessly packed, and non-graded fruit, may be mentioned as an example.

One point the farmer should remember in this connection, and that is, the wool-buyer knows infinitely more about wool than he does, owing to the fact that the farmer generally sees his and his neighbours' clips but once a year, while the buyer has wool passing through his hands almost every day in the week at certain seasons of the year. It stands to reason, therefore, that the farmer is not going to gull the buyer by selling dirt in the fleece, which the former thinks the latter will mistake for wool. The buyer will make an accurate estimate of the amount of loss the wool will suffer when bought in the unwashed condition. It would appear also that the buyer having been " once bit " is " twice shy," or how is the substantial difference in price between the washed and the unwashed fleece accounted for ? As already stated, the buyer, knowing the great variation in the amount of dirt contained in unwashed wool, makes ample provision for safeguarding his own interests.

(3) *Fewer buyers for unwashed wool.*—This is another reason for less competition. Mr. Rew's report, already referred to, contains this comment from a wool-buyer. " The desirability of washing is insisted upon, and one buyer observes that farmers limit their market by offering the wool in the grease, as the majority of spinners and manufacturers will not buy wool in that state." Another observes that " the omission to wash is an unwise and indolent habit, which sooner or later will prove most disadvantageous to farmers' interests." The figures already given afford sufficient corroboration of this last very pregnant sentence, and show that the time has already arrived when omission to wash is proving " most disadvantageous to farmers' interests."

Before leaving this item a few quotations from the Board of Agriculture and Fisheries' " Weekly Report on Market Prices " of July last in reference to wool should be noticed.

" *Edinburgh.*—The American demand is helping washed wools only."

" *Salisbury.*—Bidding very brisk, especially for washed wools."

" *Hungerford.*—Hampshire Down ewe and teg mixed made from 10¼d. to 11d. washed, and 6½d. to 7½d. unwashed." (The difference between the two prices here is sufficiently large to show the great advantage that would accrue from washing, especially if reference be again made to Table I.).

" *Newbury, Wallingford, and Didcot.*—(Prices similar to those given for Hungerford.)"

" *Marlborough.*—Prices for washed were fully maintained, but unwashed was a shade easier."

On the other hand, the only reference making favourable mention of unwashed wool is given as an afterthought in the report for Newbury : " One special lot of unwashed ewe wool made 8d." ; this surely is " the faint praise that damns."

(4) *Greater difficulty in removing dirt from the fleece after it is shorn.*—It is more difficult to cleanse the shorn fleece than when it is growing on the sheep's back, hence it probably costs more for the buyer to clean it than the seller. Of course it must not be overlooked that all wool, whether bought in the grease or washed, undergoes scouring before it is spun into yarn ; but it is not the removal of the grease so much as the dirt and grit that it is the farmer's business to attend to. There is, however, a chance of the wool containing too much grease after washing, as when a too prolonged interval is allowed to elapse between washing and shearing. The average time is generally reckoned at about ten days, but a week would be sufficient in hot weather, with the sheep in good condition, whilst a fortnight might not be too long in the case of cold weather, and with sheep in poor condition. In any case it should be remembered that the buyer is the better judge as to the amount of grease present, and it is not likely that the farmer will succeed in selling him grease for wool, even if he intended doing so.

(5) *Where wool is washed, the cost for carriage per lb. of actual wool is less.*—Whether 100 lb. of wool contains 2 or 30 lb. of dirt, the railway companies' charge on the actual 70 lb. of wool in the latter case is exactly as much as they charge for the 98 lbs. in the former case. Thus the actual freight on wool bought in Cornwall to go to Bradford, or say at Guildford to go to Huddersfield, may mean a considerable increment on the price per lb. actually given at the sale, especially where such wool is in the unwashed condition ; hence the buyer gives a sufficiently low price to allow for this. In the extract from Mr. Hargreaves' article on "Sheep-washing," Royal Agricultural Society's Journal, 1893, already given (p. 3), the last sentence quoted shows that the wool generally dealt with around Kendal is clipped from sheep which spend the whole of the year on grass ; and if clean grass land formed the lair for all sheep, there might not be so great an advantage in washing them, as in that case the amount of dirt present would be fairly uniform ; but when the rule in many districts is for sheep to be on the arable land all the year round, or at any rate during the winter months, those sheep whose lair is the wettest, and the soil of which is the stickiest, will naturally collect a larger amount of foreign

matter in the wool than those lying on a drier and more porous soil, hence the great variation in the amount of dirt found in the wool of sheep on different kinds of soil.

In Scotland, as already mentioned, the bulk of the wool is unwashed, probably for two reasons : first, that a large proportion of the sheep are grass-fed all the year round, and, secondly, that a very large proportion of the sheep are Black-faced Scotch, which clip a very inferior quality of fleece, the character of the wool being such that it can only be used for the coarser class of yarns ; as already mentioned, it is largely used for carpet manufacture, and goes from this country to America as " carpet wool." The price of this wool was quoted last July in Inverness at 4¼d. unwashed, while unwashed Hampshire, for example, was making 8d. If the 4¼d. Blackfaced wool were washed it would tend to bring its value up to 6d., when double the duty—viz., 5 cents per lb., would be charged on it if sent to America, and thus it would cost the buyer 8½d. per lb., against unwashed 4¼d.+2½ cents (1¼d.)=5½d., and 5½d. unwashed will be much cheaper than 8½d. washed, as may be gathered from Tables I., II., and III.

In districts where the sale of wool is effected through local staplers, *i.e.*, by the latter paying visits to the farmer and purchasing his wool on the spot, the necessity for getting up the commodity in a clean and attractive manner is not perhaps so obvious ; but where the, in many cases, more advantageous system of marketing wool obtains of selling by auction at local wool sales, the greatest care in preparing it for market is a *sine quâ non* if top prices are to be realised.

# FERMENTATION IN THE HAY RICK.

## I.—“SHRINKAGE IN THE WEIGHT OF HAY.”

BY B. N. WALE, B.Sc.

A note was inserted in last year's *Journal* with regard to the amount of shrinkage hay undergoes during fermentation in the rick. Last summer the matter was again investigated. As in that year hop-pockets containing weighed quantities of hay in the condition in which the bulk was being harvested, were built into two ricks. When the ricks were cut into during the winter these hop pockets of hay were taken out and again carefully weighed, the reduction in weight indicating the loss due to sweating. Four samples of *clover* hay were thus taken, one being built into one rick and the three remaining ones into another, these latter being placed respectively in the lower, middle and upper portions of the rick. Unfortunately the first sample was cut through accidentally when the rick was cut, hence the weight of its contents could not be accurately determined. The respective weights of the different samples of hay were as shown in Table on next page.

The previous year's result with one sample only, and that of *meadow* not clover hay, showed a loss of 17.33 per cent.

Where records of experiments giving the yield of hay per acre from differently manured plots are given, no allowance is made for this shrinkage, and although such records show correctly, proportionate yields from the different plots, they do not indicate the yield of actual hay available for use on the farm ; where this is required, therefore, it would seem that a deduction of at least 15 to 17 per cent. should be made from the figures usually given in reports on manurial trials on grass land.

| No. of 'Sample. | Weight of Hay when ricked. lbs. | Weight of Hay when rick cut into. lbs. | Percentage loss due to fermentation. lbs. |
|---|---|---|---|
| 1 | 54 | accidentally cut up | — |
| 2 | 67.5 | 55.5 | 17.78 |
| 3 | 51.75 | 44.0 | 14.98 |
| 4 | 55.5 | 47.25 | 14.87 |
| | | Average | 15.87 |

## II.—"THE TEMPERATURE OF HAY DURING FERMENTATION."

By H. C. L. Keable and B. N. Wale, B.Sc.

Daily thermometer readings were taken of the hay in the rick with the object of obtaining some information as to what temperature newly ricked hay may safely reach without danger.

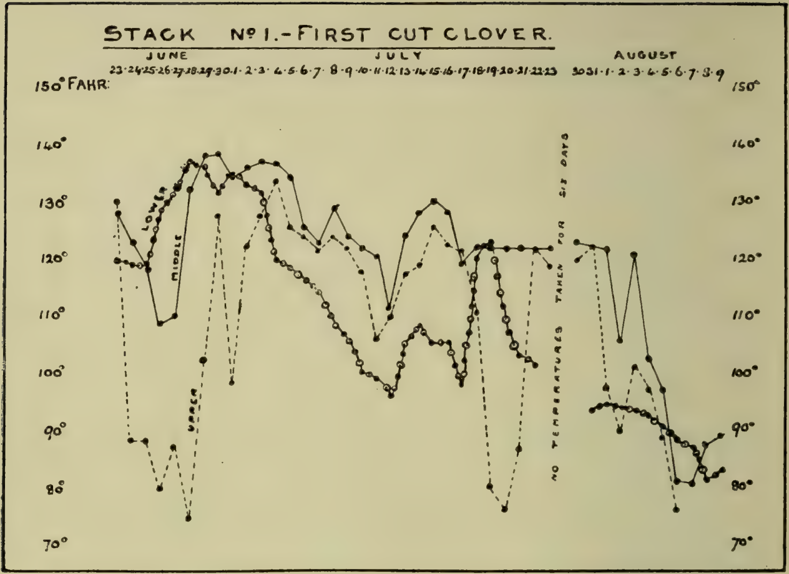
The method adopted was as follows; iron tubes 1¼ inches diameter, and from nine to ten feet long, were used. These tubes had been carefully drawn out to a point at one end to facilitate their being driven into the rick. The tubes had a number of small holes drilled through them around the pointed end to allow the heat to quickly act on the mercury of the thermometers. Maximum thermometers were pushed into the tubes by means of thin iron rods the same length as the tubes, a string was attached to each thermometer by means of which the latter was drawn out of the tube, and the temperature was then read off.

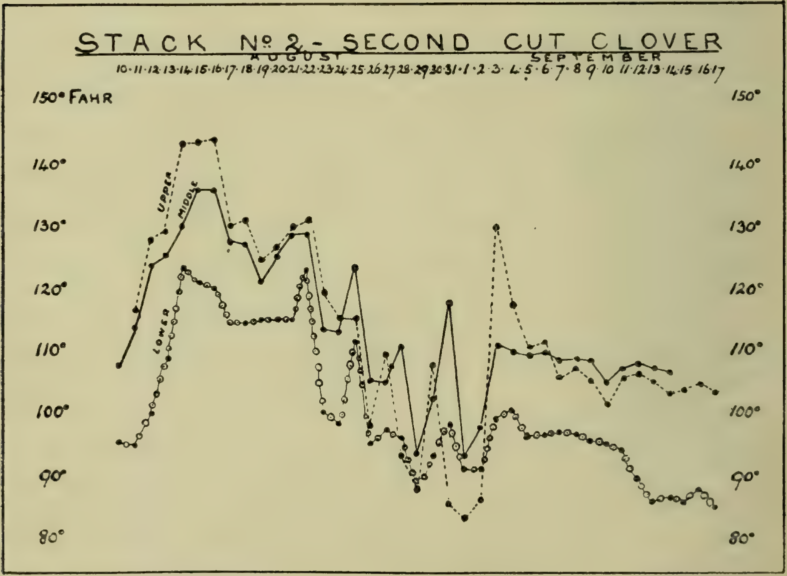
Two ricks were tested by means of the thermometers.

No. 1.—First cut clover hay containing about twelve tons.

No. 2.—Second cut clover hay containing ten tons.

Three of the iron tubes were driven horizontally into the rick from one side, and immediately after the rick was built. In


STACK Nº 1.-FIRST CUT CLOVER.
JUNE
JULY
AUGUST
23·24·25·26·27·28·29·30·1·2·3·4·5·6·7·8·9·10·11·12·13·14·15·16·17·18·19·20·21·22·23
30·31·1·2·3·4·5·6·7·8·9
150° FAHR:
150°
140°
130°
120°
110°
100°
90°
80°
70°
LOWER
MIDDLE
UPPER
NO TEMPERATURES TAKEN FOR SIX DAYS


STACK Nº 2.- SECOND CUT CLOVER
AUGUST
SEPTEMBER
10·11·12·13·14·15·16·17·18·19·20·21·22·23·24·25·26·27·28·29·30·31·1·2·3·4·5·6·7·8·9·10·11·12·13·14·15·16·17
150° FAHR
150°
140°
130°
120°
110°
100°
90°
80°
UPPER
MIDDLE
LOWER

this way the ends of the tubes reached approximately to the middle of the rick. The tubes were inserted from one to two feet above each other, the lowest tube being about 4½ feet from the ground level when the rick had done settling.

The material for rick No. 1—first-cut clover hay—was in ordinary good condition for stacking, and when cut into in December was found to have undergone a rather low fermentation, being only slightly browned and in good condition.

The material of rick No. 2—second-cut clover hay—was greener when stacked, and as was to be expected the maximum thermometer readings were somewhat higher than in the case of rick No. 1. The hay produced also showed a deeper brown colour owing to the higher temperature of fermentation.

It will be noticed from the accompanying diagrams that newly ricked hay undergoing a normal fermentation, soon reaches its maximum temperature, *i.e.*, towards the end of the first, or the beginning of the second week after the hay is put into the rick. Further, the rise in temperature is very rapid, being as much as 25° F. in the space of twenty-four hours, as in the case of stack No. 1, with the upper thermometer on the 29th and 30th of June. The fall in temperature is likewise very rapid.—July 18th and 19th of same diagram.

Both diagrams indicate that there is a second fermentation setting in approximately about three weeks after the hay is ricked; and in the light of practical experience it would seem probable that it is this second fermentation that is likely to result in danger from overheating: because the hay having undergone its previous fermentation has parted with much of its moisture, and being in a much drier condition it is far more likely to ignite.

It seems unlikely that any harm will result where the hay has not exceeded a temperature of 150° F. How much higher the temperature may safely rise it is at present impossible to say; so much depends on the size of the rick and the degree of consolidation that has taken place. The less the consolidation, the more air there is present, and the higher the temperature is likely to rise. At the same time imperfect consolidation is generally to be found in ricks of small size, but on account of the small bulk more heat is lost by radiation, and hence there is less liability to fire.

# SHEEP SHEARING.

By R. N. Dowling, N.D.A.

Too much stress cannot be laid on the fact that agricultural students intending to become flock masters, should be thoroughly conversant with the practice of shearing.

Every sheep owner knows what it means if a badly shorn fat sheep is sent into market : it gives the animal, instead of a desired level and well " filled-up " condition, a ridged and unsightly appearance along its back, which means that such a sheep will fetch less money, whereas a poorer animal shorn with nice even regular cuts running well over the backbone, will probably have its value enhanced.

It is of the utmost importance that the correct positions and methods of holding the sheep during the time it is being shorn, should be mastered.

If a beginner learns, first the way to hold his sheep, and secondly how to use the shears with a true shearing cut and not just a clip with the points, then he is fairly on the way to success.

## *Sheep washing.*

Sheep-washing generally takes place about a week before shearing, the time between the two operations depending upon the weather.

If too long a period is allowed, the grease rises in the wool too much and does away to a large extent with the benefit derived from washing.

On the other hand it is necessary to wait until the grease from the skin has risen in the wool to a certain degree before shearing, as the work is rendered much easier if such is the case.

### *Shearing-ring and pens.*

It is a good plan to arrange the hurdles so that a large outer pen is formed, having a movable hurdle leading into a small pen. The smaller pen must also have a hurdle opening out into the shearing ring.

The sheep are driven firstly into the large pen, then a few are driven from the large into the small pen, and so can be quickly and easily drawn out into the shearing ring as desired.

The shearing ground should be covered with a cheap cloth made of rough canvas. This prevents grass and other rubbish getting wound up with the fleece. It is of importance, because any vegetable matter in the fleece is detrimental, in that it makes it unsatisfactory for dyeing.

A coarse and a smooth whetstone should be placed handy for sharpening the shears, these are rubbed firmly and squarely up and down the bevelled edge, the coarse stone being used first and then the fine. The shears must be held firmly, and a good way is to kneel down on one knee and rest the blade to be sharpened on the other leg, the edge being upward.

It is advisable to have a boy where several shearers are at work. He has a small pad on the end of a stick which he soaks in oil or tar and dabs on any open cut, also he collects the pieces of wool and marks the sheep. Stockholm tar is often used to dab on cuts. It leaves an unsightly mark, but this is an advantage when a gang is shearing, as it tends to make the shearers more careful. Carbolised oil acts as an antiseptic, and helps to keep the flies away from cuts. It is clean and inexpensive, and can be made as follows :—

1 oz. of Carbolic Acid (95 per cent. purity) is added to one pint of Olive Oil. Then thoroughly shake to mix.

### *Method of catching, drawing, and throwing the sheep.*

The sheep in the pen should be approached quietly and one seized by the hind leg. Then release leg and grip the flank firmly in one hand, guiding the sheep out with the other.

In this way the dirty state of the wool, owing to sheep falling down in the dunged and sticky pen, is obviated.

If the animal is gripped by the wool, the fleece is liable to be torn and damaged.

One method of throwing a sheep is to stand on the near side, then lean over the body and place the left arm over the sheep's neck, so that the hand comes between the animal's forelegs. Take a grip over the breastbone. The right hand is placed under the belly, a firm hold is taken and the sheep lifted, so that its weight is thrown against the shearer's legs. Then sit the sheep gently down on its rump, or turn it over on its side as desired.

The method of shearing usually practised in Sussex and other parts where Southdown sheep are kept, is given below, and it is hoped, that by reference to the plates, a clear idea as to the methods of holding and shearing the sheep may be conveyed.

Throw the sheep and sit it on its rump. Place knees firmly and squarely under or about shoulders of sheep and balance the animal so that it leans without strain against your legs. Hold head of sheep back with left hand in order to stretch the neck, and thus obtain a taut condition free from loose skin or wrinkles. Hold shears firmly in right hand and insert the points in the wool just over the right forearm. Take a cut up to a point just behind the right ear. (See Plate I., Fig. 1.)

Take a few strokes up the neck, so that an opening is made and the wool falls naturally round the neck. Clean under the throat and round the left side of head and cheek. (See Plate I., Fig. 2.)

With the left hand turn the sheep's head, so that the throat or under side of neck is resting on your left leg. Hold the sheep's head in position with the left hand. Clean off wool over the head, and then take a cut in a semi-circular direction around the neck, from the under side round to just beyond the spine. In this way the shears will be cutting against the fall of the wool. (See Plate II).

Continue down to the left forearm, clean out the breast and down part of belly. A good plan is to then clear the belly of wool. This can be done as the sheep is sitting up on rump. (See Plate III., Fig. 1.)

Another way is to lay the sheep down on its right side, the shearer then gets behind it and places his right leg over the sheep's body in between the animal's front legs. The shearer then rests on his left knee, which is placed against the sheep's back, and with his left hand he can keep the " near " back leg out of the way, while he clears the belly with a longitudinal cut. The udder and inside of legs can be cleared in this position. (See Plate III., Fig. 2.)

When the belly is clear, take a right hand circular cut, working round from belly to about an inch beyond the backbone. This clears the spine and makes a better finish than if the clip is taken to the spine and not over it. When the work is advanced a little below the shoulder, push the head of the sheep between your legs and put your knees firmly behind its shoulders for support. This will cause the body of the sheep to bend outwards in a convex manner, and will prevent looseness of skin and give a nice firm surface for cutting. Take care that the animal is leaning against your legs and not forward with all the weight on its stomach. This is likely to cause a serious internal strain if not properly done. (See Plate IV., Fig. 1.)

When the loin is reached, it is a good plan to lower the sheep so that it rests on its side, place your left leg over its neck, so that the knee is on the ground at the back of sheep and the toe is between sheep's mouth and brisket, thus forming a loop between your knee and toe, in which the sheep is held fast without pressure. Then kneel on the right knee and continue shearing over the loin, rump and dock. (See Plate IV., Fig. 2.)

When the left side is quite clear to the tail, sit the sheep up on rump as when starting, and work down the right side of sheep. This should be done with the left hand, because the shears will then meet the wool and closer and better work will be the result. (See Plate V., Fig. 1.)

When the fleece is off, treat any cuts with carbolised oil, mark the sheep and let it go. Then wind the fleece as explained hereafter.

*Methods of shearing used in parts of Kent.*

Throw the sheep so that it lies on its right side on the ground. Stand behind the sheep's back, then place the left leg over its body, so that the foot comes between the animal's front legs. Lift the sheep's head with the left hand, so as to raise the neck off the ground. (See Plate VI., Fig. 1.)

Clean off the head and open down to brisket, by taking a right hand cut from the spine to the underside of neck and down to the forearm. (With big Kent sheep it is a decided advantage to have the sheep resting on its side as much as possible). (See Plate VI., Fig. 1.)

Clean the breast and work down the belly to the udder. This can be done as the sheep is sitting on its rump, or as shown in Plate III. (See Plate V., Fig. 2.)

Then use the left hand and shear down the right side, working from the belly round to the back. (See Plate V., Fig. 1.)

When low enough down the body put the sheep's head between your legs and continue over loin to dock as explained previously. Turn the sheep over and repeat down the left side.

There are many other ways of " opening " or starting when shearing sheep. In parts of the Midlands and North, it is the custom to sit the sheep up on its rump and start by shearing over its head, continuing down over the right cheek and opening down neck to breast-bone.

With the right hand shear up the left side and round to back of neck, then change hands and cut the right side of neck with left hand work. In this way the shears will be meeting the fall of the wool all round the neck. This is done down to shoulders, thus leaving the head and neck quite clear. Next the breast and belly are cleaned off.

Then the right hand is used to clean off the left side of sheep in the usual way, and the left hand for the right side.

Sometimes, both sides are shorn down as far as the shearer can reach when standing, then the loin and hind quarters are finished off afterwards, when the sheep is lying on the ground.

In parts of the south-western counties, it is customary to clear out the breast and belly first while the sheep is sitting up as shown in Plate VII., then to open up neck and work round body in the usual way.

Again, the " opening " is sometimes done by cleaning off the hind left leg first and eventually doing horizontal work along back instead of working from belly to back in circle as previously explained. This method does not produce such nice clean work, but is quicker than the foregoing.

### *Shearing with Machine.*

There are various makes and types of sheep-shearing machines, but the principle is more or less the same. As shown in Plate VIII. the driving wheel is fixed to a stump (an old railway sleeper is a good thing to use), it is connected by small cog wheels and a rod or wire to the clipping portion. When in action the top knives move rapidly over the fixed lower fingers in a reciprocating action and thus cut quickly and easily through the wool.

In one method the sheep is first placed in a sitting position, the shearer's knees being behind the shoulders of the sheep, to afford support. Then the breast is opened and continued right down belly until this is quite open and free from wool, as shown in Plate VIII. Then the head is cleared and the clippers work down the neck to breast. The neck is then opened and the work continued down both sides as when using shears.

### *Rolling and winding the fleece.*

In the South the following method is largely adopted. (See Plate IX.). Lay the fleece out flat on the canvas so that the clean side is downwards. Fold the neck end in, take the outside folded end in one hand and fold in the sides to centre with the other. Draw out the wool from neck portion to make the " bind," or band. Twist it a few times and place one foot at bottom as shown, then gradually stretch and twist until a strong ropelike band is obtained. Place the right foot on the band to prevent it coming undone, kneel down and lean forward to roll wool towards oneself. The sides must be tucked in as the fleece is being done up, and it should be firmly and compactly rolled into a bundle as shown in Plate IX. The band is then wound round the fleece and the end tucked in to prevent its coming undone.

In some parts the fleece is rolled first and the band made afterwards.

It will be advisable to carefully consider the following points :—

(1) To catch, draw and throw the sheep in a workmanlike manner.

(2) To thoroughly learn the various ways of holding the sheep during the process of shearing.

(3) To firmly grasp shears as shown in illustrations, and to make a shearing cut and not just a clipping cut. To obtain this the bottom blade of shears should be resting on body of sheep and should point out the wool, while the upper blade is brought up against the lower to produce the cut. It is desirable to use a drawing cut, and to do this the shears are moved into the wool and drawn back as the cut is being made. It is well to keep the handle a very little lower than the points, to avoid scratching.

(4) Never pull the wool up with the free hand. If this is done the skin is raised to the shears and a nasty cut will be the result. The skin can be pulled taut by pressing down and back on it with the free hand.

(5) It is well to bend the part being shorn outwards, making it convex in shape as far as possible—this will render the cutting much easier. Great care must be taken, however, that the sheep is supported properly and not to throw the weight of its body forward so as to be a strain on the stomach or other parts, as serious damage can accrue from this.

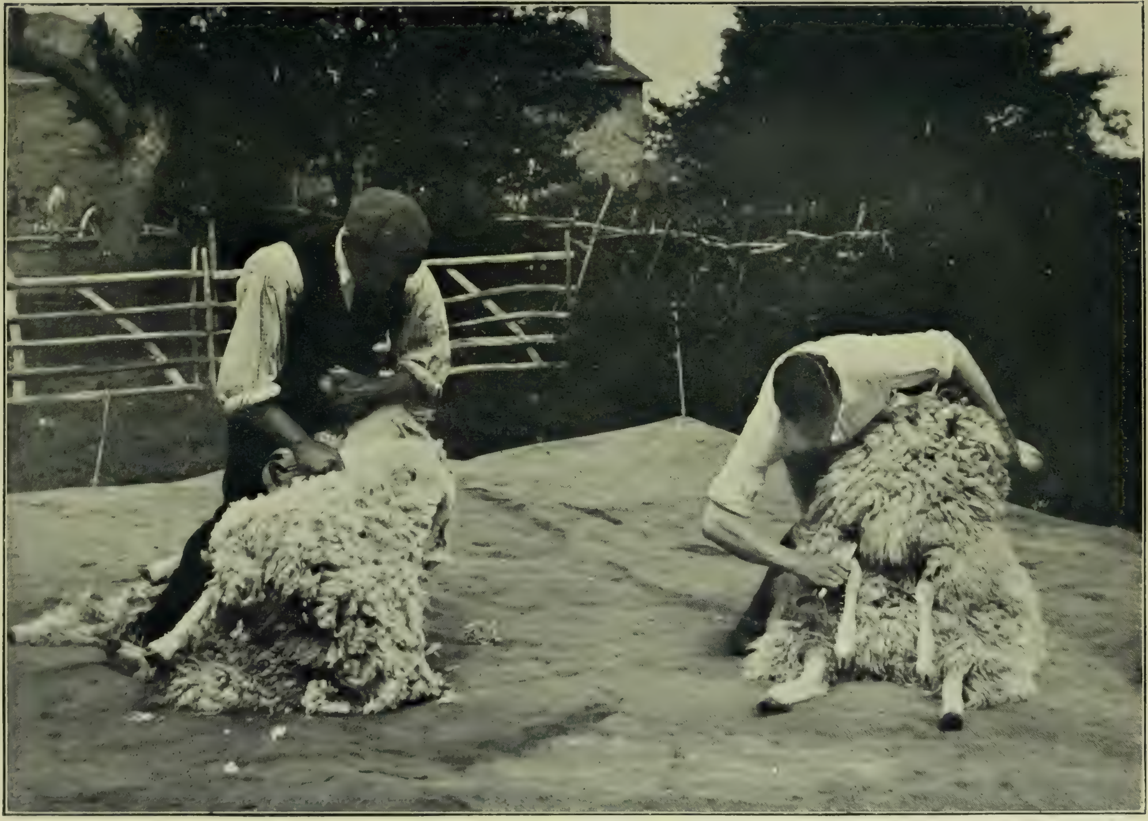
(6) Always cut against the fall of the wool where possible—by so doing neat work will be obtained. About two inches from point of shears is the part that should be used for cutting, the points of shears should only be used for trimming.

(7) Rapid work can be done on long wool sheep like Kents, by taking wide cuts 1¼ to 1½ inches, but if neat work is required then ½ inch to ¾ inch should be used.

(8) The fleece should be kept intact.

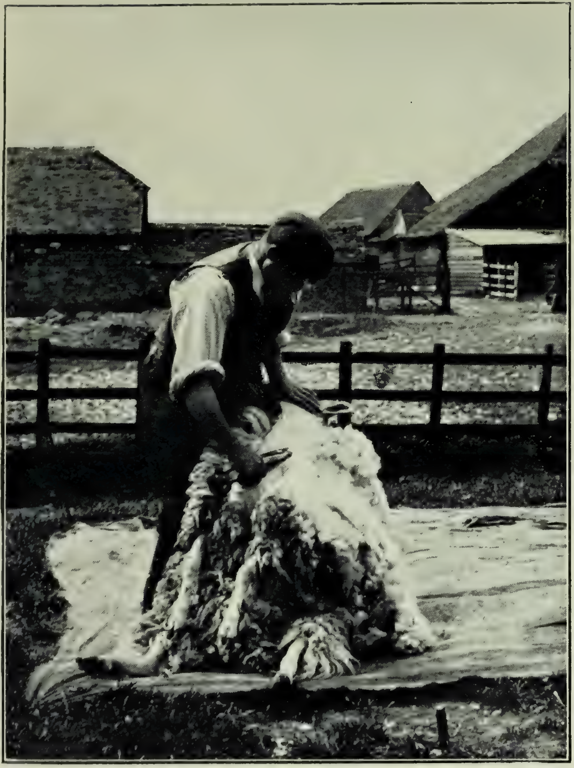
(9) To shear well it is necessary to do left and right hand work.

Fig. 2. PLATE I. Fig. 1.



*F. Edenden, photo.*

Plate II.



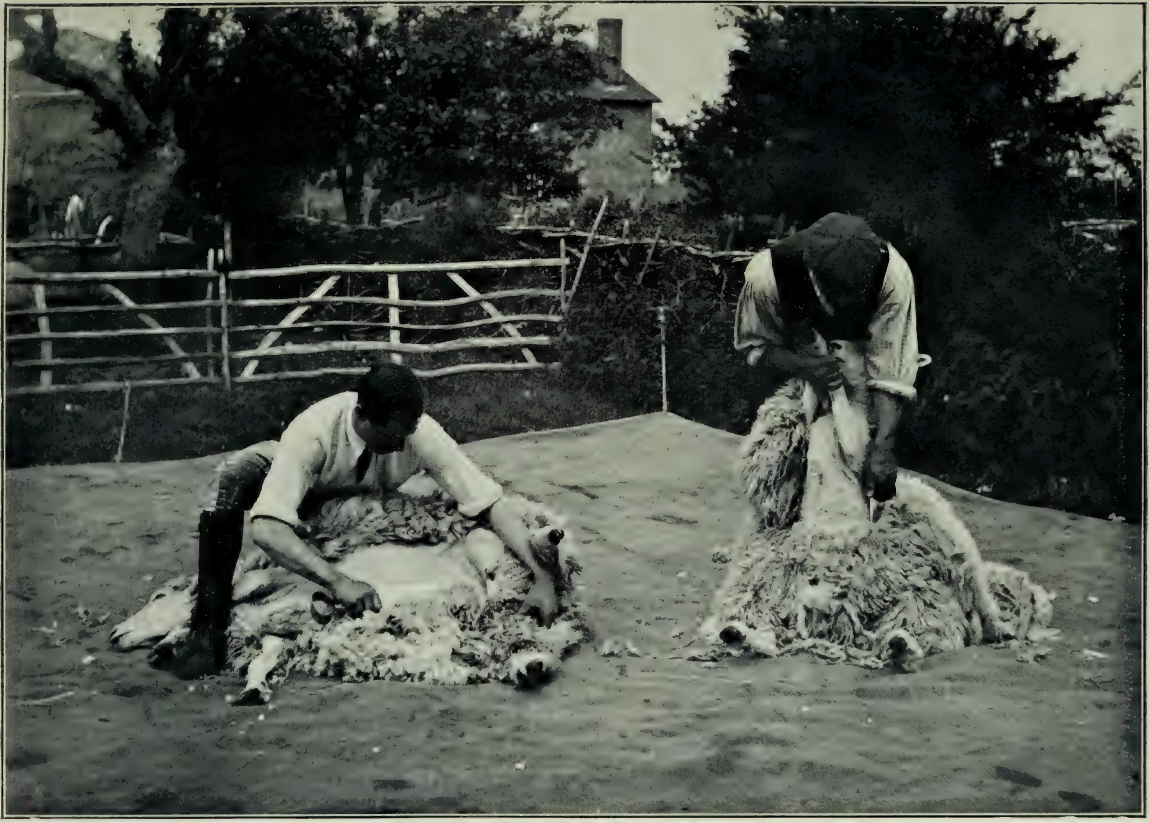
*F. Edenden, photo.*

Plate VII.

*F. Edenden, photo.*

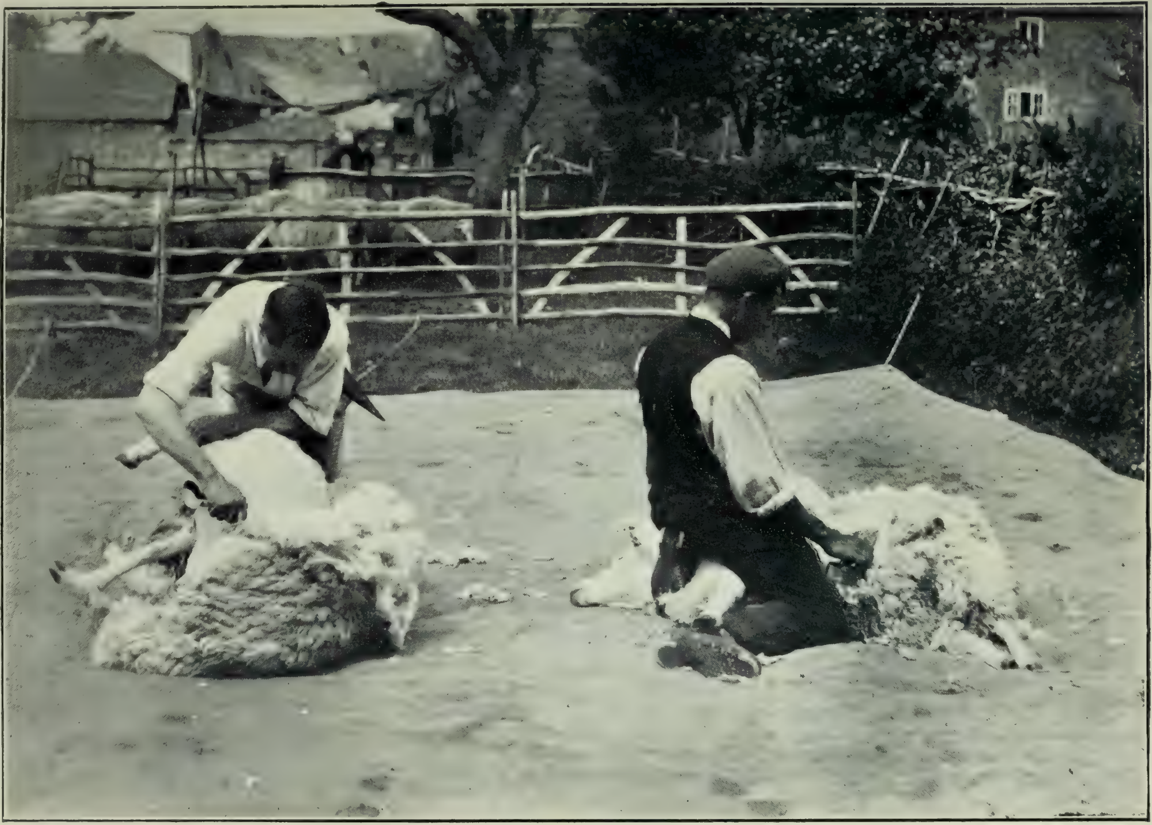
Students at a Sheep-shearing Class.

Fig. 2. PLATE III. Fig. 1.



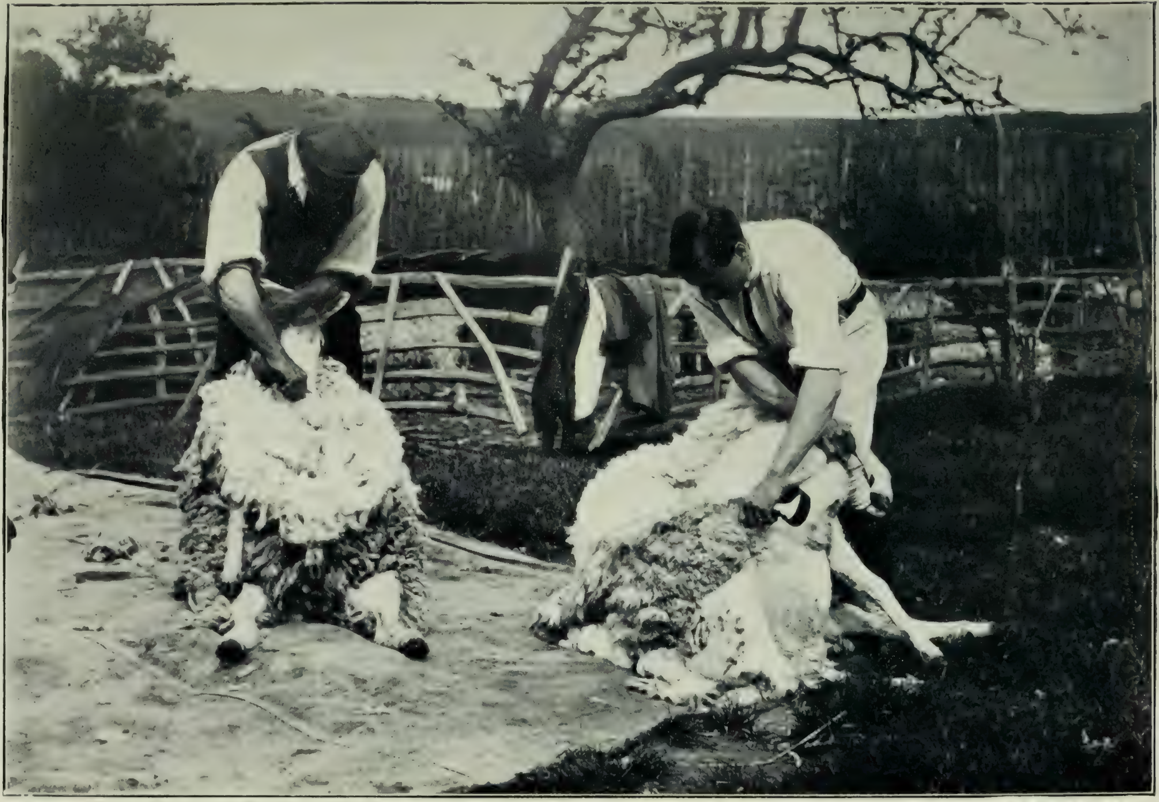
F. Edenden, *photo*

Fig. 1. PLATE IV. Fig. 2.



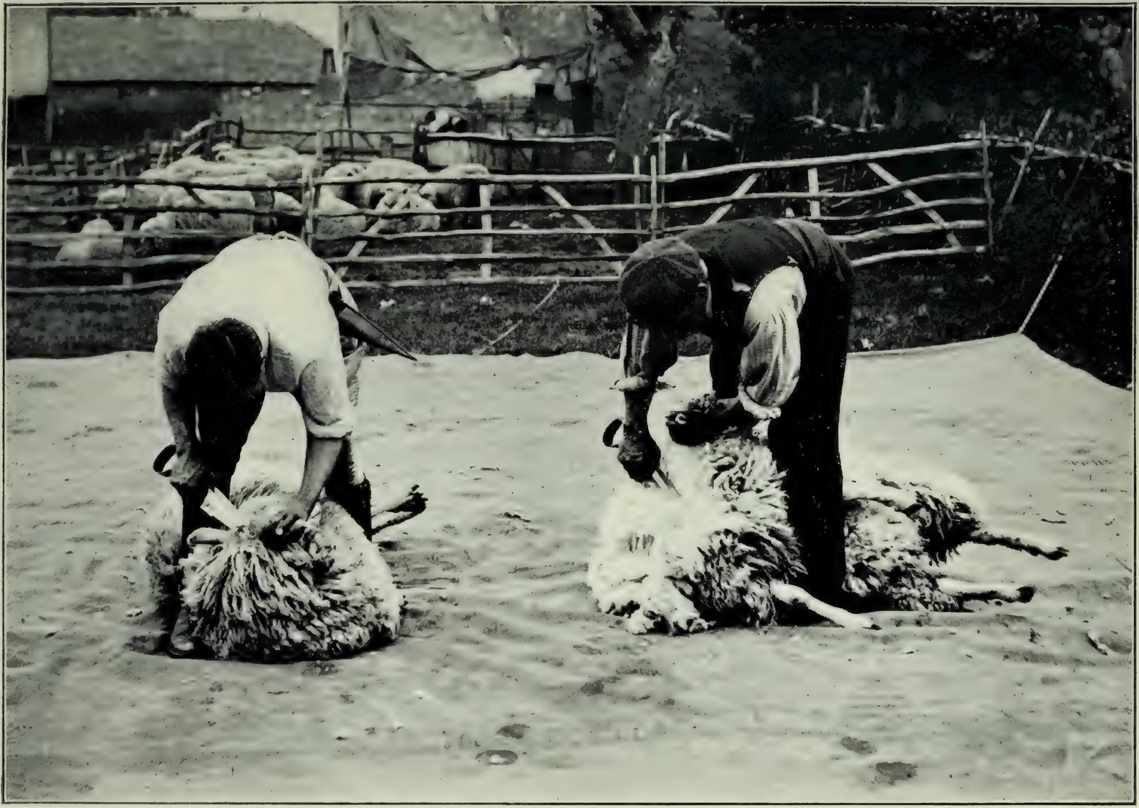
F. Edenden, *photo.*

Fig. 2. PLATE V. Fig. 1.



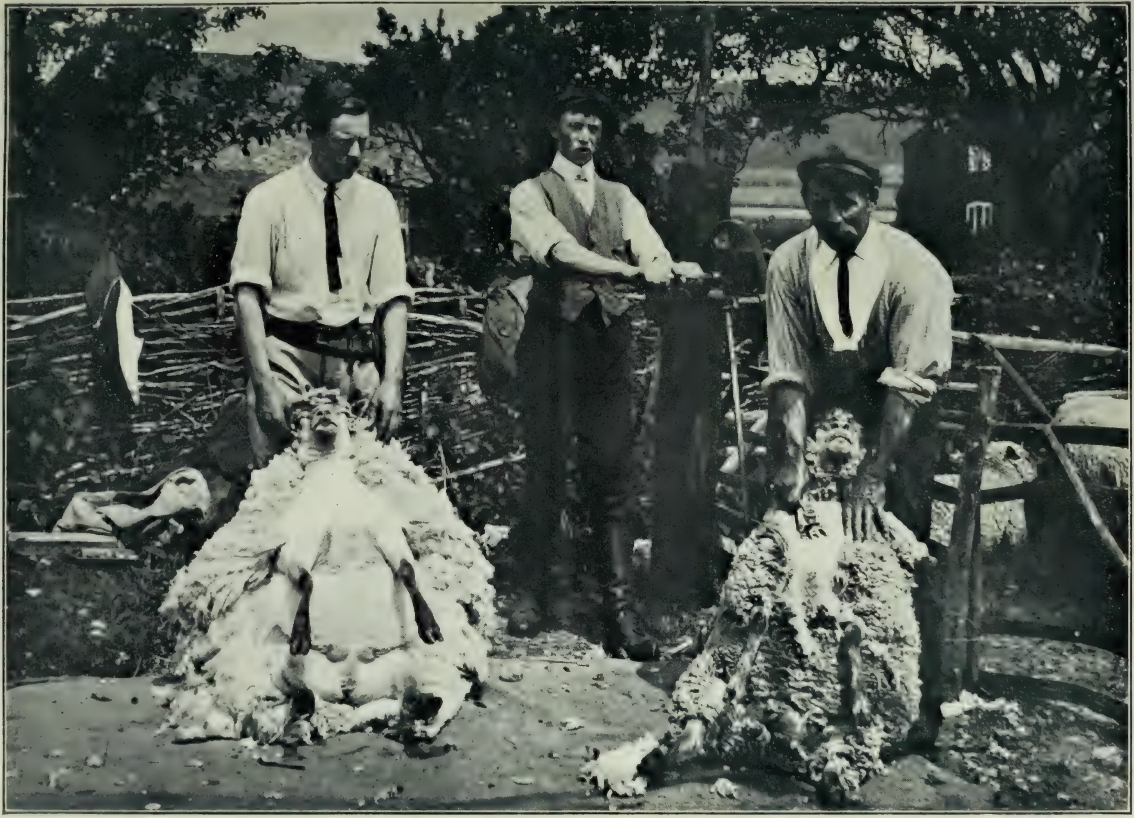
F. Edenden, photo.

Fig. 1. PLATE VI. Fig. 2.



F. Edenden, *photo.*

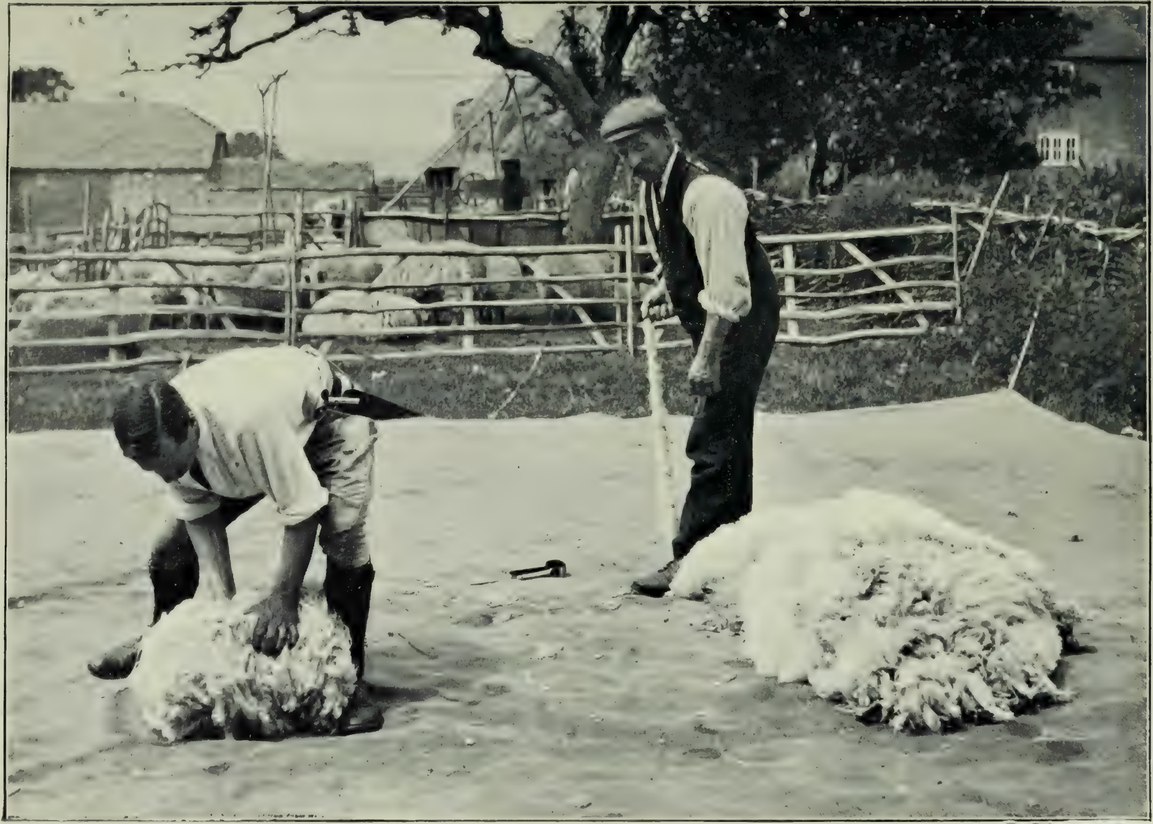
PLATE VIII.



F. Edenden, photo.

SHEARING WITH MACHINE.

PLATE IX.



F. Edenden, photo.

# THE DAIRY HERD.

By James Mackintosh, N.D.A., N.D.D.

During the past year increased attention has been given to this section of the live stock of the farm, and several changes have been made in order to afford a practical illustration of all the latest improvements in the management of a herd of milking cows.

The most important improvement affecting the dairy herd is the erection of a new cowhouse. The present one is too small, having stalls for only fourteen cows, and it is also defective with regard to floor space, ventilation and mode of entrance. The new building, which is nearly ready for occupation, takes up the site of two partially covered yards, and has stalls for twenty cows—ten a side—with a seven-foot passage in the middle. The cows face the walls, and there is a feeding passage at each side leading to a food-preparing room and root store. The floor and internal fittings are of the most approved type, and no effort will be spared to show how to produce market milk in such a way as to satisfy all sensible up-to-date hygienic regulations.

With regard to the cows many changes have been made. A number of Red Lincoln cows have been sold, and their places taken by heifers bred on the farm, while several new Shorthorn cows and heifers have been bought.

A new Shorthorn bull—Persia (99920 C.H.B.)—was bought at Birmingham in February, 1908, and has been in use in the herd this season with satisfactory results ; a lot of seven heifer calves by him are very promising.

The weight of milk given by each cow morning and evening has been determined as in former years, and in May, 1908, the work of sampling and testing the milk of every cow for the percentage of butter-fat was begun, and has been carried on regularly. The samples are taken at the time of weighing—the morning's and evening's samples being placed in separate bottles—and tested once a week ; a small amount of preservative is added to each bottle to keep the samples fresh. This sampling and testing of the milk of each cow in addition to the daily weighing makes the milk records of the College herd complete in every respect, and the information thus obtained has been utilised in drafting cows out of the herd and in the selection of this year's heifer calves.

In addition to supplying milk for the College, for butter-making and for sale, the cows were utilised for the following experiments :—

1. Feeding Oil to Milking Cows. *Journal* No. 17, p. 218.
2. Feeding Cake during summer. *Journal* No. 18, p. 67.
3. Soya Bean Cake as a food for Dairy Cows. *Journal* No. 18, p. 225.

The students have shown great interest and energy in learning the actual process of milking, but care has been taken that the instruction in this work should in no way lower the milk yields. Beginners have to practise for a time on cows which are nearly dry, while the systematic weighing and testing at once brings out all marked variations in quantity and quality.

For Table of Milk Records see page 65.

Columns V. to VII. of the above table give the average percentage of fat in the morning's and evening's milk, and the complete average. Column VIII. gives the yield of milk of each cow in terms of milk containing 3 per cent. fat, for the purpose of comparing cows that give a large yield of medium or low quality milk with those that give a moderate yield of high quality milk. This comparison is useful where butter or cheese is made from the milk, but where milk selling is practised the actual yield of milk is more important.

Cows 1, 7 and 18 L.R. have been disposed of during the year. No. 1 milked very well until a hip was accidentally dislocated, and soon afterwards she was sold to the butcher.

No. 7 was sold fat, and No. 18 just after calving.

Nos. 2 and 7 Shorthorn and the Ayrshire have also been sold, the two former after calving, and the latter in a fat condition.

## MILK RECORDS OF THE DAIRY HERD.

### SEASON 1908-09.

| No. of Cow. | Weeks in Milk. | Actual Yield of Milk in lbs. | Average Daily Yield in lbs. | Average % Fat in Milk. | | | Calculated Yield of Milk in lbs. of 3% Fat. | Num. of Calves. |
|---|---|---|---|---|---|---|---|---|
| | | | | Morn. | Even. | Average. | | |
| Lincoln :— | | | | | | | | |
| No. 1 | 25 | 6828 | 39.0 | 3.06 | 4.10 | 3.47 | 8231 | 7 |
| No. 7 | 37 | 4818 | 18.6 | 3.90 | 4.18 | 4.01 | 6440 | 7 |
| No. 11 | 43 | 7067 | 23.4 | 2.81 | 3.77 | 3.20 | 7538 | 4 |
| No. 13 | 43 | 7689 | 25.5 | 3.22 | 3.92 | 3.51 | 8996 | 4 |
| No. 14 | 55 | 8399 | 21.8 | 3.47 | 3.87 | 3.64 | 10190 | 4 |
| No. 18 | 42 | 6570 | 22.3 | 2.59 | 3.92 | 3.13 | 6854 | 4 |
| No. 21 | 46 | 6432 | 19.9 | 3.41 | 4.24 | 3.78 | 8070 | 1 |
| Shorthorn :— | | | | | | | | |
| No. 1 | 42 | 8156 | 27.7 | 3.24 | 3.56 | 3.58 | 9732 | 3 |
| No. 2 | 37 | 5201 | 20.0 | 2.83 | 3.95 | 3.29 | 5703 | 3 |
| No. 3 | 73 | 11391 | 22.2 | 2.72 | 4.17 | 3.31 | 12568 | 3 |
| No. 4 | 67 | 8467 | 18.0 | 3.20 | 4.25 | 3.65 | 10301 | 3 |
| No. 5 | 45 | 8020 | 25.4 | 2.82 | 4.12 | 3.36 | 8982 | 3 |
| No. 7 | 43 | 6326 | 21.0 | 3.67 | 4.02 | 3.82 | 8055 | 2 |
| Aver. for year of above 13 cows | | 7335 | | | | | | |
| Ayrshire | 28 | 3440 | 17.5 | 3.11 | 4.29 | 3.59 | 4118 | 6 |
| Guernsey | 52 | 4286 | 11.7 | 4.39 | 5.56 | 4.94 | 7946 | 5 |
| Jersey | 47 | 3216 | 9.7 | 4.92 | 6.15 | 5.45 | 5842 | 1 |

The herd has been increased in number by the addition of six Lincoln heifers bred on the farm, and seven Shorthorns bought during the autumn and winter. Representatives of the following dairy breeds are also kept :—Ayrshire, Jersey, Guernsey, Red Poll, and Kerry.

# FEEDING CAKE TO COWS ON GRASS.

By James Mackintosh, N.D.A., N.D.D.

During the summer of 1908 an attempt was made to obtain some further information on the much discussed question of feeding concentrated food to milking cows during the summer in addition to a plentiful supply of grass.

Many experiments have been carried out in order to find whether such feeding is advisable or profitable, but it cannot be said that the matter has been finally settled ; perhaps the most general result has been that the addition of cake to a good supply of grass does not cause a corresponding increase in the quantity or quality of the milk, and that from this point of view such feeding is uneconomical.

The theory underlying the giving of this additional food is that as the summer advances the grass loses succulence and digestibility, and is not such an ideal food for milking cows as it was earlier in the season ; hence something extra is required to keep the ration balanced and to induce the cows to yield the maximum quantity of milk. This point of view is based on the assumption that early summer grass is an ideal food for a cow in milk because it would be the sole food in a state of nature ; but no one will hold that the up-to-date dairy cow is to be compared with a cow in a state of nature ; one has only to think of a two-weeks' old calf trying to utilise four to five gallons of milk per day to see that the dairy cow of the present has been so far removed from its natural state as to require consideration from a different standpoint.

Theoretically, dairy cows ought to have some concentrated food in addition to the grass of May and June, for such grass, though more succulent and digestible than that of July and August is less rich in compounds of real nutritive value, and contains substances which frequently cause unnecessary scouring. Also, the change to such a food as early grass usually causes the quality of the milk to fall for a short time, and the concentrated foods should be useful in counteracting this effect.

In practice, extra foods should only be given to cows if it is found that such feeding yields a profit. But the financial aspect of this question cannot be decided by simply ascertaining the milk yield and finding if the cost of the food is more than made up by the increase in milk ; the quality of the milk, the live weight of the cows and the effect of the food on the general health of the animal must also be taken into account, and it is the introduction of these latter factors which render the solution of this question a matter of great difficulty. The subject is still more complicated by the varying effect of different concentrated foods, and by the fact that the times of feeding seem to have some relation to the quality of the milk.

As already mentioned, many experiments have been and are being conducted with a view to arriving at a definite conclusion on the subject, and in the meantime all trials which shed more light on the different aspects of the question are worthy of careful consideration.

The experiment conducted on the College farm commenced on June 11th and ended on August 19th, and comprised five periods of two weeks each. Six spring-calving cows were chosen and divided into two groups of three, each group giving approximately the same quantity of milk, which contained very similar amounts of butter-fat.

*Period I.*—For the first fortnight all the cows received grass only, and the figures obtained for this period have been used as a basis for the calculations in the tables given below. During the next three periods the cows of group II. received 4 lbs. mixed Linseed and Undecorticated Cotton Cake each per day, as follows :—

*Period II.*—2 lbs. Cake morning and evening.

*Period III.*—4 lbs. Cake in the evening.

*Period IV.*—4 lbs. Cake in the morning.

*Period V.*—All cows again received grass only, in order that the effects of the withdrawal of the concentrated food might be noticed.

*Weighing and Sampling.*—The milk of each cow was weighed at each milking, and samples were taken morning and evening and tested daily for the percentage of fat.

*Milking.*—The hours at which milking was commenced were 5.45 a.m. and 3.15 p.m., giving intervals of 9½ and 14½ hours,—intervals very similar to those necessarily adopted on many milk-producing farms.

*Results.*—The results of the experiment are given in the following tables :—

Table I. (see p. 70) shows percentage of butter-fat in cows of Group I. (Grass only).

Table II. (see p. 71) shows percentage of butter-fat in cows of Group II. (Grass and Cake).

Table III. (see p. 72) shows total yield of milk in lbs.

Table IV. (see p. 72) shows total yield of butter-fat in lbs.

*Table I.*—The figures in this table are in full agreement with what is already known of the variation of the fat in milk. In every case except that of No. 21 (morning) the percentage of fat shows an increase in Period V. compared with Period I. (see column K.) due to the advance in the period of lactation. Nos. 18 and 21 illustrate the fact that if milked at unequal intervals of time cows frequently yield milk at the end of the longer interval which is below the legal minimum in quality, although the average for the day is well above 3 per cent.

*Table II.*—Here the figures show the same expected rise in quality from Period I. to Period V. (column K.), but the effect of the concentrated food is seen by studying columns C. E. and G. In C. and E. the figures show a general increase except in two cases, but in column G. the amount and uniformity of the rise is very marked in both morning and evening milk.

A slight rise in percentage of fat would be expected simply from the fact that a change is made in the ration, but the results given in column G. seem to indicate that feeding the concentrated food in the morning has more effect on the quality of the milk—especially morning's milk—than the giving of such food either in

TABLE I.—SHOWING PERCENTAGE OF BUTTER-FAT IN MILK OF COWS GETTING GRASS ONLY.

| | | A. | B. | C. | D. | E. | F. | G. | H. | K. | L. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Period I. 14 days. | Period II. 14 days. | Inc. + or Dec. — over Period I. | Period III. 14 days. | Inc. + or Dec. — over Period I. | Period IV. 14 days. | Inc + or Dec. — over Period I. | Period V. 14 days. | Inc. + or Dec. — over Period I. | Inc. + or Dec. — over Period IV. |
| Cow No. 1 S. | Morning | 3.00 | 3.04 | +.04 | 2.93 | —.07 | 2.99 | —.01 | 3.12 | +.12 | +.13 |
| | Evening | 3.76 | 3.77 | +.01 | 3.95 | +.19 | 4.01 | +.25 | 3.92 | +.16 | —.09 |
| Cow No. 18 L. | Morning | 2.50 | 2.54 | +.04 | 2.32 | —.18 | 2.38 | —.12 | 2.52 | +.02 | +.14 |
| | Evening | 3.79 | 3.57 | —.22 | 4.20 | +.41 | 4.27 | +.48 | 4.05 | +.26 | —.22 |
| Cow No. 21 L. | Morning | 2.85 | 2.77 | —.08 | 2.76 | —.09 | 2.87 | +.02 | 2.52 | —.33 | —.35 |
| | Evening | 3.93 | 3.72 | —.21 | 3.84 | —.09 | 3.66 | —.27 | 4.32 | +.39 | +.66 |

## TABLE II.—SHOWING PERCENTAGE OF BUTTER-FAT IN MILK OF COWS GETTING GRASS AND CAKE.

| | A. | B. | C. | D. | E. | F. | G. | H. | K. | L. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Period I. Grass only. 14 days. | Period II. 2lbs. Cake. Morn. and Even. 14 days. | Inc. % or Dec. — over Period I. | Period III. 4 lbs. Cake. Even. only. 14 days. | Inc. + or Dec. — over Period I. | Period IV. 4 lbs. Cake. Morn. only. 14 days. | Inc. + or Dec. — over Period I. | Period V. Grass only. 14 days. | Inc. + or Dec. — over Period I. | Inc. + or Dec. — over Period IV. |
| Cow No. 5 S. Morning | 2.31 | 2.39 | +.08 | 2.21 | —.10 | 2.85 | +.54 | 2.70 | +.39 | —.15 |
| Evening | 4.02 | 4.26 | +.24 | 4.47 | +.45 | 4.77 | +.75 | 4.07 | +.05 | —.70 |
| Cow No. 11 L. Morning | 2.40 | 2.67 | +.27 | 2.56 | +.16 | 2.80 | +.40 | 2.60 | +.20 | —.20 |
| Evening | 3.70 | 3.63 | —.07 | 4.00 | +.30 | 4.13 | +.43 | 3.80 | +.10 | —.33 |
| Cow No. 13 L. Morning | 2.52 | 2.79 | +.27 | 2.53 | +.01 | 2.87 | +.35 | 3.22 | +.70 | +.35 |
| Evening | 3.82 | 3.85 | +.03 | 4.22 | +.40 | 4.30 | +.48 | 3.77 | —.05 | —.53 |

## TABLE III.—SHOWING TOTAL YIELD OF MILK (IN LBS.)

| | A. | B. | C. | D. | E. | F. | G. | H. | K. | L. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Period I. | Period II. | Inc. + or Dec. — over Period I. | Period III. | Inc. + or Dec. — over Period I. | Period IV. | Inc. + or Dec. — over Period I. | Period V. | Inc. + or Dec. — over Period I. | Inc. + or Dec. — over Period IV. |
| Cows of Group I. Without Cake | 1320 | 1260¼ | —59¾ | 1212½ | —107½ | 1101 | —219 | 1030 | —290 | —71 |
| Cows of Group II. With Cake | 1331½ | 1276¼ | —55¼ | 1205½ | —126 | 1091 | —240 | 965¾ | —365¾ | —125¾ |

## TABLE IV.—SHOWING TOTAL YIELD OF BUTTER-FAT (IN LBS)

| | A. | B. | C. | D. | E. | F. | G. | H. | K. | L. |
|---|---|---|---|---|---|---|---|---|---|---|
| | Period I. | Period II. | Inc. + or Dec. — over Period I. | Period III. | Inc. + or Dec. — over Period I. | Period IV. | Inc. + or Dec. — over Period I. | Period V. | Inc. + or Dec. — over Period I. | Inc. + or Dec. — over Period IV. |
| Cows of Group I. Without Cake | 43.21 | 40.36 | —2.85 | 39.62 | —3.59 | 36.35 | —6.86 | 35.11 | —8.10 | —1.24 |
| Cows of Group II. With Cake | 40.82 | 40.80 | — .02 | 39.03 | —1.79 | 38.28 | —2.54 | 32.60 | —8.22 | —5.68 |

the evening or part morning and part evening. A similar result is noticed by Ingle in the "Transactions of the Highland and Agricultural Society," (1903, pp. 154, 173 continued.)

The increase in the percentage of fat was maintained throughcut a period of six weeks, being indeed most marked during the last two weeks, but although the effect was prolonged over a greater length of time than is usually the case one cannot say that it is permanent. It may be that the frequent changes in the times of feeding were instrumental in preventing the customary fall to the normal quality.

The figures in column L. show a large decrease in the percentage of fat in Period V., *i.e.*, when the allowance of cake was stopped and grass became again the sole food.

All the cows in this group gave milk containing under the legal minimum of fat at the morning milkings, yet the daily average allows quite a satisfactory margin.

*Table III.*—This set of figures is perhaps the most important and interesting from the milk-sellers' point of view. A comparison of the amounts of milk yielded by the two groups of cows shows that the extra food had little or no effect in keeping the yield of milk from diminishing at the usual rate as the period of lactation advanced. The lesser decrease in the case of Group I. (columns K and L) is largely accounted for by the fact that two of the cows (Nos. 1S and 21L) fall in yield at a slower rate than the others ; this has been clearly shown by the yearly record.

*Table IV.*—The results shown in this table are more remarkable than those in any of the foregoing, largely because they are unexpected. Columns C, E, and G, show clearly that the concentrated food has been effective in keeping up the total amount of butterfat yielded.

In Group I. the total quantity of fat decreases uniformly throughout the periods, but in group II., the decrease is much smaller during Periods II., III., and IV., when the cake was being given. In Period V., when the cake allowance was withdrawn, the total amount of fat yielded by Group II. showed a decrease from Period I. almost identical with that recorded from Group I. (col. K).

The figures given above also show that the slight increase in the percentage of fat due to the cake, stated in Table II., does not convey a clear or accurate idea as to the actual benefit and return obtained from the use of the concentrated food.

The increase in the total yield of butter-fat would be beneficial from the butter and cheese-maker's standpoint, as he would have an increased production of butter and cheese, but the milk-seller has no corresponding advantage, because milk is almost universally sold at a stated price per gallon, independent of quality; milk containing 4.5 per cent. of fat only fetches the same price as milk containing 3 per cent. of fat.

*Estimate of Value of Increase due to extra food.*—It has been shown in Table III. that the concentrated food had no appreciable effect in keeping up the milk yield, therefore no increase in quantity can be credited to the food.

Table IV. shows a slower decrease in the total yield of fat during the cake periods, and this represents increase due to the food. If we assume that, without the cake, the total yield of fat in Group II. would have decreased at the same rate as in Group I., we find that the actual increase due to the cake was approximately 8¾lbs. butter-fat; this should yield 10 lbs. butter.

| Cost of Cake fed to Cows :— | £ | s. | d. |
|---|---|---|---|
| 2¼ cwts. Linseed Cake, 8s. 3d. per cwt. | | 18 | 7(½) |
| 2¼ ,, Undec. Cotton Cake, 5s. ,, ,, | | 11 | 3 |
| | £1 | 9 | 10 |
| Approximate return in Butter : | | | |
| 10 lbs. Butter at 1s. 1d. per lb. | | 10 | 10 |
| Difference | | 19 | 0 |

From this calculation it may be stated that the return in the form of Butter is only equal to one-third of the value of the cake given; but, as mentioned earlier, other circumstances, such as increase or decrease of live-weight, effect on general health, etc. as well as the manurial residue for the land (which in this instance may be estimated at 6s.), have to be taken into account before giving an accurate and final decision on this subject.

*Summary of conclusions :—*

(*a*) The feeding of 4 lbs. cake per day to cows getting a plentiful supply of grass has no appreciable effect in preventing the usual decrease in yield of milk due to the advance in lactation.

(*b*) The feeding of cake as stated does increase slightly the percentage of fat in the milk, but it cannot be said that this increase is permanent. With changes in the times of feeding and quantity fed, made at short intervals, such increase might be kept up over a longer period than is usually the case.

(*c*) When the allowance of cake was given in the morning the greatest increase in percentage of fat was obtained, and this increase was most noticeable in the morning's milk.

(*d*) The total amount of butter-fat yielded was increased by the concentrated foods. A gradual decrease took place during the weeks of the trial, but this decrease was much less in the group of cows receiving cake.

(*e*) The cost of the foods used is not equalled by the estimated return from the extra butter-fat produced. Practically no return is obtained if the milk is sold as such, but if butter or cheese is made the foods give a return equal to about one-third of their cost.

# LIVE STOCK DEMONSTRATIONS.

## COWS.

By T. R. Robinson, F.S.I.

A short syllabus, given in the last number of the *Journal*, proposed that systematic Stock Classes should range over the entire year. The autumn term, devoted to fattening animals, has already been treated with in some detail. It is now intended to pass over some of the intermediate sections of the above-mentioned syllabus, coming at once to division 4 :—

Dairy Cows (*a*) Classes for inspection.
(*b*) Judging by records.

These field and yard classes should be made as much as possible to synchronise with lectures that fully cover the ground of Dairy Farming. The idea to aim at is not only to afterwards illustrate the lectures with the Cattle, Crops, etc., but to bring out true facts, and interest those who, by previous training, may not have had opportunities of handling Farm Stock of any kind. It would be a fatal mistake to begin with such things as the history of tribes or strains or scales of points; such things, important as they are, should be relegated to second or third year men, the beginners being far more keen on every day management.

A course of lectures on the lines suggested below, makes an intelligent introduction to the practical classes :—

1. Selection of a Dairy Farm.
2. Stocking the Farm.
3. Rotation of Crops.
4. Winter Management.
5. Summer Grazing.
6. Cost and Returns.

These are extended and followed on as fully as time permits, with information on Dairying, including Milk-selling, Cheese and Butter making, bye-products, etc., given by men who have made such things their speciality.

By adopting a scheme organised on these lines, the student can be kept in touch with what is actually taking place on a properly equipped educational establishment. The ideal Dairy Farm, as sketched out in the lecture room, can be contrasted with that which one has to put up with in practice, and any alterations made on the farm from time to time (either of a temporary or permanent character) is an endeavour to make these conditions more perfect. Thus a young man may be taught how to think and work out improvements—a training which is of far greater value to him, than if dumped down at once in a so-called " Model " environment. In a like manner are the cattle dealt with, improvements or mistakes being effected by breeding and management, the laboratory, so to speak, of the lecture room being the cow byres and pastures. The information given to the old time farm pupil that " K O W spells cow, now go and milk," is not enough. To judge by inspection and records, involves close observation, and some technical skill.

Classes, as stated before*, should be small, especially if those attending them have had little experience of stock. Demonstrations may be divided into three or four parts ; a working scheme of which is now described :—

1. Some quiet cows are selected, preferably of two or more breeds, and attention at once called to the udder.

Taking a Jersey as an example, the standard says, " Fore udder full in form and not fleshy " ; Hind udder the same, but well up behind ; the maximum points allowed being respectively ten and eight out of a total 100. The teats count seven and the milk veins three. A possible thirty-eight per cent. of the cow, therefore, under review, and although " scoring " is not yet being attempted, it is manifestly of great importance in teaching that the known records should be contrasted with the touch, shape, size, etc., of those parts of the animal under observation (see Plate V., of a very typical Jersey udder).

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* See *Journal S.E.A.C.* 1908.

So far the demonstration has been simple and fairly obvious, but none the less important. The students should also note the size of the milk veins and milk " well," understanding the differences as seen in these parts, between a fresh calver and one nearly dry; also the shape of the teat of a rich milker (often funnel shaped), compared to that yielding a poor percentage of butter fat (see illustrations).

Without laying too much stress on this teat theory, or that of the next, namely, the amount and duration of the milk yield, as compared with the size and shape of the escutcheon (see Plate VI.), yet the time may be profitably filled up by explaining what is meant by up-growing fine-hair, and loose and somewhat scurfy skin. The horizontal and vertical parts of this so called milk mirror, also the two somewhat triangular patches or " ovals " of *downward* growing hair so often seen near the base at the back of the udder in a good dairy cow, also calls for comment. All these points (but with no attempt at classification) and including the measuring of the length of the tail, have the advantage of simplicity and may afterwards lead on to the more difficult problem of the selection and breeding of cattle.

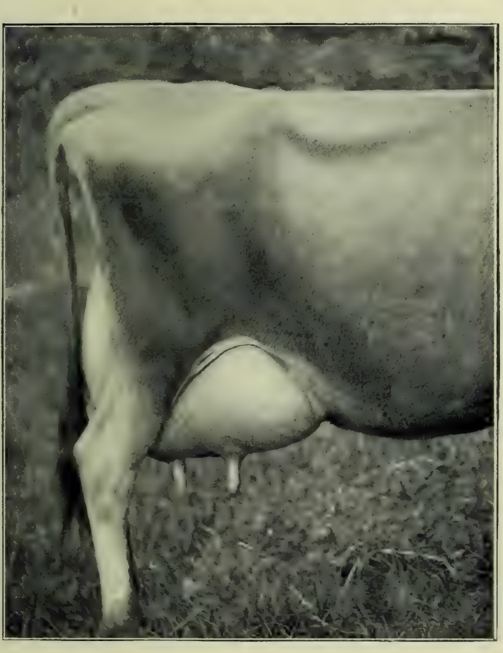
2. The second demonstration concerns the general appearance. The question asked is : " Does the animal look like being a good milker, or one more likely to put on flesh, or one not likely to do either."

The accepted version is " wedge-shaped," as viewed from various positions.

(*a*). Look for the thin chine, the somewhat narrow loin, particularly at the rib end, gradually broadening out, and the hips well apart. (Contrast shoulder and hips with a feeding steer).

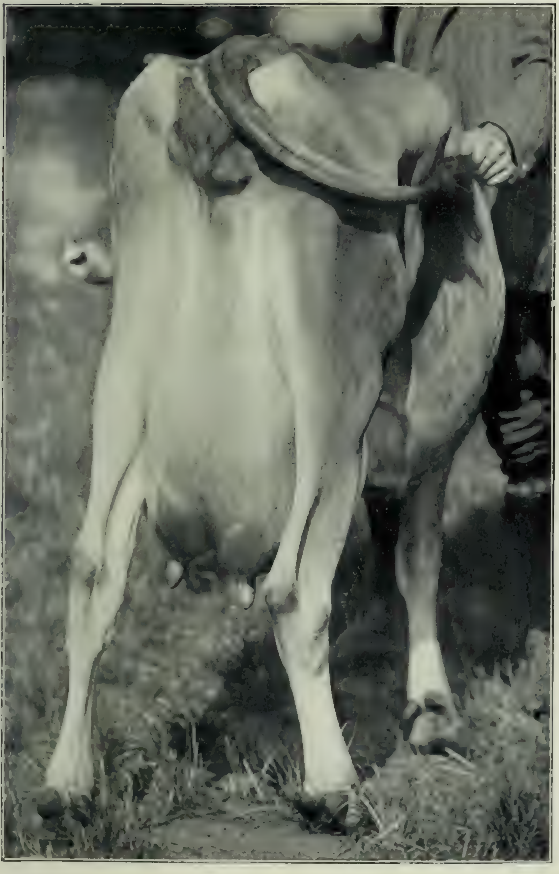
(*b*). The wedge as seen from the side, the clean cut throat, the light brisket. Trace the underline to the floor of the udder, and note that this underline, if placed along the flank, takes an upward curve, so taking away the idea of the wedge. Handle the flank, feeling whether it is thick and heavy or lean and thin. If the cow is in poor condition, and gives little milk, yet has a thick flank, the inference is, that if put on better keep, the food would probably go to putting on weight, rather than to the production of milk. Take one other example often met with in a heavy fleshed

PLATE V.



Showing thin flank, fore-udder and teats.

PLATE VI.



Showing incurving thighs, escutcheon and "ovals."

cow in a town dairy, the animal being a first-rate milker. The flank in this case may be heavy or light, and the inference drawn is that she has been very heavily fed. Taken in conjunction with other things, the thin flank is indicative of a good milker.

(*c*). The wedge-shape as seen from the front, the thin neck, thick heart girth (one of the points denoting constitution). The wide spread ribs, and still wider abdomen, denoting digestive capacity, that is the capacity of converting food into milk.

(*d*). Compare the rugged backbone of a Channel Islander to that of a compact feeding bullock, and the long quarters (hips to tail head) and incurving thigh as viewed from behind of a dairy cow, with that of a steer that is being fed.

(3). *Quality.* This word is used to *express several meanings.* Thus a good quality beast may mean one that has aptitude to fatten, or possesses in a marked degree breed points, or appears to have sound constitution, or shows extreme fineness. For the purpose of this, the third stock class " quality " is differentiated into the visible signs that denote good health, quantity of milk and " richness."

One way of testing quality is to feel the skin and coat near the last rib of the animal, when the head is very slightly turned towards you. Feel first with the flat of the hand, rubbing it gently a little way to and fro, then pick up the hide between the thumb and finger. Is the skin supple, oily, thin, or thick and harsh ? Explain the meaning of this and contrast the unctuous or sometimes papery hide of a housed Jersey, with that of a thick and shaggy coated Galloway. An intermediate example should be taken next, *i.e.*, the mossy hair and sappy " touch " of a well-bred dual-purpose shorthorn. Give the information as to quality and quantity of milk obtained from each cow, saying that the Galloway in most cases merely brings up her own calf. The harsh and unyielding skin of a poor animal will also be a useful object lesson. Note again the udder, especially the colour and fineness of the skin of the escutcheon. Turning to the head, point out the crumpled horn, dished face, yellow ear, and prominent eye of the Channel Islander, as compared with the shorthorn. The clean joints, small feet, are also outward signs that go to make up the quality in a rich milker.

A summary of the points may be divided up into the three headings indicative of—

| BUTTER FAT. | QUANTITY OF MILK. | STRONG CONSTITUTION. |
|---|---|---|
| Udder and teats Jersey character. | Udder large, Shorthorn, Ayrshire or Redpole type. | Free from all blemish or soreness. |
| Touch, unctuous. | Skin medium thickness. | Skin rather thick, plenty of hair. |
| Horns yellow at base. | Horns somewhat thin. | |
| Ears yellow inside. | Ears very mobile. | Ears well fringed. |
| Head dished. | Head inclined to length. | Prominent bright eyes. |

In all cases it is desirable to see the nostrils well apart and rather high.

4. *Judging by records.* A breeding herd offers every opportunity to practise this system. A most usual scale of points is the one adopted by the British Dairy Farmers' Association.

Modifications, however, may be made to suit existing circumstances. For instance, total solids need not be taken into consideration, the estimate being based on date of calving, average of the day's milk and butter-fat. The dairy cows at the East Kent Show were judged on these lines last year.

One cannot too strongly recommend the value of keeping accurate records, not only from the educational point of view, but as a guide to these very practical questions, which cow should be sold or fatted, or what price should be put on a "record" calf.

# THE HOP GARDEN.

The hop garden was manured in the winter with 30 cwt. per acre of wool waste, and in the spring with a dressing of 6 cwt. per acre of fish guano. This was sown round the hills, and dug in, and 3 cwt. per acre of superphosphate was sown over the ground and worked in with the nidgit.

In the spring a heavy nidgit, with three horses, was run once up the centre of each alley, and during the summer the ground was cutivated lightly with a single horse nidgit. Vermin attacked the bine early in June and necessitated repeated washings till August.

The hops were washed six times with the horse machine, the outsides being finished by hand; they were washed three times with quassia and soft soap, 8 lbs. of each being used per 100 gallons, and three times with 4 lbs. of soft soap and half a gallon of proprietary wash per 100 gallons.

The yield amounted to 9 cwt. per acre, of very fair quality, though picking had to be commenced before the hops were ready owing to the presence of vermin, and the price realised, £7 15s. per cwt., was satisfactory, considering that the garden is planted with a number of varieties for demonstration and experimental purposes.

# FRUIT PLANTATIONS.

The Fruit Plantations are in the process of renovation ; most of the apple and pear trees which were seriously damaged by canker have been removed, and the following varieties planted :—Worcester Pearmain, Bismarck, Newton Wonder, Bramley's Seedling, Lane's Prince Albert, and Beauty of Bath.

The Cold Harbour plantation, including the nursery, has been cleared of a great many trees, and the plantation planted up with Black Currants, 6 feet apart, the varieties being Carter's Prolific, and Boskoop Giant. In the lower plantation, four trial plots have been planted up with the following varieties :—

| 1. *Kitchen Apples.* | *Season.* |
|---|---|
| Thomas Rivers | September |
| Foster's Seedling | October |
| Hector Macdonald | October |
| Striped Beaufin | November |
| Norfolk Beauty | December |
| Crimson Bramley | December |
| Hambling's Seedling | December |
| Encore | February |
| Royal Late Cooking | |

| 2. *Dessert Apples,* | |
|---|---|
| Langley Pippin | August |
| Hunt's Early | August |
| Benoni | September |
| American Mother | October |
| Houblon | December |
| Rival | December |
| Barnack Beauty | January |
| King's Acre Pippin | January |
| Mrs. Phillimore | January |

*Yellow Gooseberries.*

Brown Girl
Leveller
Gunner
Langley Beauty
Langley Gage
Golden Gem.
Leader
Cousen's Seedling
Pilot

*Red Currants.*

Fay's Prolific
La Fertile
La Versaillaise
La Constante
Raby Castle
Knight's Late Red
La Hative
Cherry
Mammoth.

| 3. *Pears*, on Quince Stocks. | *Season.* |
|---|---|
| Clapp's Favourite | August |
| Fertility | September. |
| Dr. Jules Guyot | September. |
| Conference | October. |
| Emile D'Heyst | October and November. |
| Durondeau | October and November. |

| 4. *Plums.* | *Season.* |
|---|---|
| Tragedy | June. |
| Early Yellow | July. |
| Purple Egg Plum | August. |
| Heron | August. |
| Giant Prune | September. |
| Admiral | October. |

The Apples are on Paradise Stock, three trees of each variety, and the Gooseberries and Currants nine of each variety.

In the Loganberry plot, a number of American berries of recent introduction have been planted for trial. They include :—

| | |
|---|---|
| Blewer's Giant | Blackberry. |
| Everbearing tree | Blackberry. |
| Sugarplum | Blackberry. |
| Mammoth | Blackberry. |
| Iceberg | White Blackberry. |
| Phenomenal | Blackberry and Raspberry cross. |
| Giant Cardinal | Raspberry. |
| Giant Farmer | Black-fruited Raspberry. |
| The King | Raspberry. |
| Early Surprise | Raspberry. |

About a quarter of an acre of ground near the loganberries has been planted with two varieties of raspberries—Superlative and Hornet.

The French Garden is now in working order and a commencement has been made in the raising of early vegetables, etc.

# FORESTRY.

The nursery contains several thousand plants of Corsican Pine, Larch, Scots Pine, Spruce, Douglas Fir, Thuja Gigantea, Pinus Gerardiana, Oak, Ash, Sweet Chestnut and Black Walnut.

The areas planted out consist of : One acre of Oak, Ash and Sweet Chestnut mixed ; half-an-acre of Ash pure ; one acre-and-a-half of Spruce ; one acre of Corsicans ; and one acre of Scots Pine. These plantations have been established from one to five years.

There are also one-and-a-quarter acres of Coppice with Oak Standards, under a fourteen year rotation ; half-an-acre of underwood awaiting cutting, and a small Arboretum.

In consequence of the Hop Department requiring the site of the present nursery, a new and larger nursery, $\frac{1}{4}$ acre in extent, has been formed. It is proposed to stock this in October, 1910, with a large variety of young trees, which will be most advantageous for students who require special instruction in Forestry.

# POULTRY.

*Breeds.*—The following breeds of fowls have been mated :—

| | |
|---|---|
| Speckled Sussex. | Red Sussex. |
| Buff Orpington. | White Orpington. |
| Faverolles. | Langshans. |
| Black Leghorns. | Old English Game. |

In some cases the pens are duplicated, enabling the College to be in a position to supply unrelated breeding stock of the same variety. Besides the above, several useful crosses will be made during the season of 1910.

*Breeding Trials.*—A series of trials has been undertaken to show the dominance, etc., of certain characteristics,—white clean legs, " Faverolles," also a short legged bird similar to the French " Courtes Pattes " ; the latter being an exceptionally good laying fowl.

*Egg Production.*—Trap nests and egg records are kept from some of the breeding pens, and selected stocks of Black Leghorns, Buff Orpingtons, and of other breeds, are expected to be raised this year. The mild winter has been generally favourable for egg production.

*Instruction.*—Classes are regularly held during term time, and facilities are given for practical work. Briefly stated, this includes the general management, from mating the stock in the autumn, to the raising, killing, trussing, and the sale of eggs and stock birds during the year.

*Exhibiting.*—Only a few shows have been attended, but owing to the interest taken in this department, it is hoped to do something more in this direction.

# REPORT

ON

# ECONOMIC ZOOLOGY

FOR THE

YEAR ENDING APRIL 1ST, 1909.

BY

FRED. V. THEOBALD, M.A.

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# INTRODUCTORY NOTE.

The number of communications received during the year ending April 1st, 1909, was 2,850. Of these the majority were concerning common and well-known insect pests and the spraying of fruit trees.

No new attacks of any very special interest were reported and none observed. The present summer has, however, brought constant new pests to light.

By far the worst attacks during 1908-1909 were those of Eelworm and Frit Fly in Corn, no less than 200 communications being received concerning these parasites, and many more since the date this report closes.

Concerning the pests of domesticated animals a number of inquiries have been received in connection with the Sheep Nasal Fly, which has been more in evidence the last two years than is usual in the southern parts of England.

A series of trials with nicotine wash have been carried out, with the main object of testing its effects on all manner of insect pests. The results show the great insecticidal value of nicotine, not only for haustellate insects but also for certain mandibulate forms at all stages of their growth, and for others such as Winter Moth when young.

A series of experiments have also been conducted and are still being continued on greases and grease-banding, not only for Winter Moth, but as the table (p. 46) shows, for several other fruit tree pests. The difficulty of obtaining a long lasting grease has probably now been overcome. American and German Moth Glues have been included in the trials.

FRED. V. THEOBALD.

*April 1st,* 1909.

# ANIMALS INJURIOUS
# TO MAN'S DOMESTICATED ANIMALS.

## **The White Worm of the Fowl** (*Heterakis inflexa* Rud.).

The presence of this worm in fowls in Devon was reported by Mrs. Hopkins at Woodbury, Devon, in May, 1908. In the communication received it was stated that "the man found one of the young white Wyandottes (three months old) gaping as if it had 'gapes' and after a day or two he pulled out the large white worm enclosed in the bottle." The chick was killed and examined, and also revealed caecal disease.

Whether or not this worm was very prevalent was not said, but death in many of the chicks could be traced to infectious gastro-enteritis due to *Coccidium tenellum*—the parasite of white diarrhoea in poultry, and apparently the cause of blackhead in turkeys.

In September Dr. Greene also sent specimens of this worm, with a note that he found eight of them in the digestive tract when making a post-mortem, and that the owner had lost a great many chicks apparently from this cause.

The White Worm (*Heterakis inflexa*) is a fairly widely distributed parasite in poultry, living in the alimentary canal. It reaches often as much as 12 cm. in length in the female; the male being smaller, seldom more than 8 cm. They sometimes occur in such masses in the intestines that they cause a temporary stoppage, quite large plugs of them being found. Their colour varies from yellowish, through dull grey to almost pure pearly white. They mainly occur in the duodenum, and the presence of the worm as here recorded is apparently very unusual. It is seldom that fatal results are brought about by them, but such have come to my notice. In any case, they cause cachectic conditions in the birds, and steps should always be taken to rid poultry of them.

These worms develop direct from ova ingested by birds from contaminated food or soil. They may easily be expelled by giving the bird a santonin pill of three grains for a fowl, one grain for a chick. About an hour after each pill has been administered a teaspoonful of sweet oil should be given.

The importance of these parasites is more indirect than direct, for they weaken the health of the birds and so they are more liable to such incurable diseases as tuberculosis and fowl cholera.

## **The Sheep Nasal Fly** (*Oestrus ovis*, Linn.).

During the past year no less than ten complaints of this insect attack have been made in Kent and Surrey alone. It has frequently for many years been sent me from other parts of Britain, but has been seldom reported in those two home counties in any numbers, as far as I know until lately.

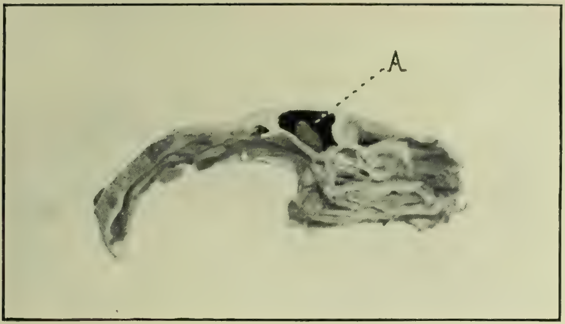
I have noticed also at Wye that this warble fly has been much more abundant. One morning this summer I found no less than twenty at rest on one outhouse. Generally a single female or so has been found during the year.

I have had this fly sent me from all parts of Britain, where it seems to be uniformly distributed wherever sheep are kept in abundance. It has also made its way to Australia, New Zealand, East Africa, and is also found in North and South America. With the constant importation of sheep from Britain to foreign parts, and also of Merinos from the Continent, we are sure to see a wider and wider distribution of this fly.

The Sheep Nasal Fly was described in 1761 by Linnæus. Brauer, in his "Monographie der Oestriden," p. 183, (1863) records it from England, France, Spain, Germany, Italy, Dalmatia, Sardinia, Corsica, Asia, Africa (Cape), North America and South America in Brazil and Chili. Macquart recorded it in the Canary Islands.

In Australia, Froggatt tells us it has been chiefly found in the Blue Mountains, N.S. Wales, and that although it has only been noticed recently it was probably introduced many years ago. It is probably native to Asia, being well-known in sheep in India.

PLATE I.



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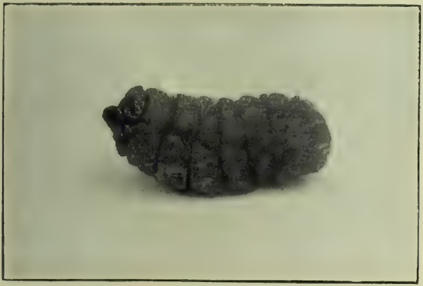

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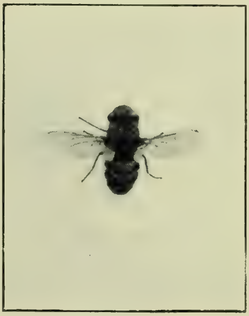

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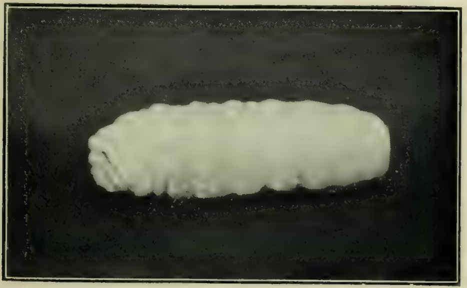

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(*Edenden.*)

THE SHEEP NASAL FLY (*Oestrus ovis*).

1. Maggot A in sinus ($\frac{1}{4}$ nat. size) ; 2. Fully mature bot (slightly enlarged) ; 3. Adult (nat. size) ; 4. Second stage of bot (twice nat. size).

This fly has also been referred to as the Sheep Gad Fly and Nostril Maggot or Fly. The disease produced by the larvae has been called by various popular names, such as "snuffles," nose maggot, grub-in-the-head, false-gid, and oestral vertigo. The name Gad Fly must not be used. Gad Flies are quite distinct insects, which bite, and belong to the family called *Tabanidae*. Their larvae feed in the ground.

### *Life-history.*

The fly which belongs to the family of Warble Flies, or *Oestridae*, is like other members of the family, quite harmless, its mouth parts being so rudimentary that it can take but little food, and that only from the nectar of blossoms. The size varies from 10 to 14 mm. The colour of the fly is also varied, the head and thorax are dull greyish-yellow to silvery-grey, densely covered with little elevated black and dark brown spots and specks. The abdomen is short and thick, and composed of five segments or rings, variegated velvety dark brown and greyish to straw colour, often with a dull silvery sheen in places ; beneath there is a dark spot in the middle of each segment. The legs are greyish-brown, and the tarsi are brown. The wings are transparent, and fold tightly over the body when at rest ; the alulae are large and dull white. The head is curiously puffed out and white below, and to some extent is swollen at the sides. The eyes, in life, are almost purple, at other times brown. Three well marked ocelli are seen on the top of the head. The male can be told from the female by its eyes almost uniting whilst in the female they are wide apart.

### *Time of appearance.*

I have taken flies in July, August, and September. The earliest record I have is on July 3rd, the latest September 23rd. I believe, however, it occurs also in June.

### *Habits of the Fly.*

Like all *Oestridae*, the adults are very sluggish when at rest. This is especially so in dull and cold weather. On such occasions I have found the flies sheltering in the crevices of wattle hurdles, and especially on sheds and lodges composed of feather boards, the flies sheltering close beneath them. I have also found them sheltering beneath the over-lapping woodwork of a greenhouse, and on two occasions in crevices in the roughened bark of oak trees. In Wales I have found them sheltering on stone walls, and even under boulders on mountain sides. In dull cold weather they can be knocked off such places, and readily fall and remain in a cataleptic state for some hours if left alone. But directly specimens were put in a warm place they crawled up the sides of the boxes, but did not attempt to fly.

Artificial heat, however, did not make them very active. As soon as bright sunlight, if unaccompanied by cold wind, occurs, they soon revive and become very restless. They then fly with great rapidity, dashing off into the air so rapidly that one can scarcely see them start. It has been said that they are quiet when on the wing. This is not so, for I have frequently heard them buzzing—a kind of low burr—when hovering in the air over a sheep ready to strike it. They seem equally to dislike wind, and one seldom can see them near sheep on a gusty day.

Another locality where I have seen them sheltering in inclement weather is on reeds and flags along small water ways and dykes. This was first pointed out to me by a shepherd, and by sweeping the flags, etc., I caught quite a number.

That the flies do not feed is a popular idea, but I am sure that they take the nectar from blossoms where the females may sometimes be found ; this I have especially noticed on the Flowering Rush and on *Compositae*.

Copulation takes place in the air. I have seen the males searching for the females on rushes, etc., and when in copula fly rapidly away, the male above.

This insect is found mainly in low lying districts, but also occurs along dry hillsides and on upland pastures. I have also seen it in abundance in the Welsh mountains. I took one female in 1899, on Moel Hebog in North Wales (2,566 feet), near the summit resting on a stone wall.

Females may live for six weeks.

The female settles on the nostrils of the sheep and may be seen holding on for a few seconds only, or longer. She may either lay eggs or deposit living young. I have twice watched females laying their eggs on the nostrils. They held on in a lazy manner, and on examining the sheep after as many as fifteen ova were taken off the inside of the rim of both nostrils. On several other occasions I have seen the ova on the nostrils. Steel says that the eggs hatch in a few days and then the young crawl up the nostrils. The exact length of the egg period is not known. The flies also seem to deposit living young.

Cooper Curtis speaks of "The young larvae having been deposited within the rim of the sheep's nose." Riley also speaks of the larvae being deposited. More recently Collinge has shown that both ova and living young may be produced by the fly and placed on the sheep's nostrils. He explains this somewhat unusual phenomena by a sudden change taking place in the weather, rain or a lower temperature ensuing, the females remain inactive, and may be found on fences, etc., and during this period some of the ova develop in the body of the parent, and on the return of warm weather she deposits the living young which have hatched from the ova in the body of the female in the meanwhile.

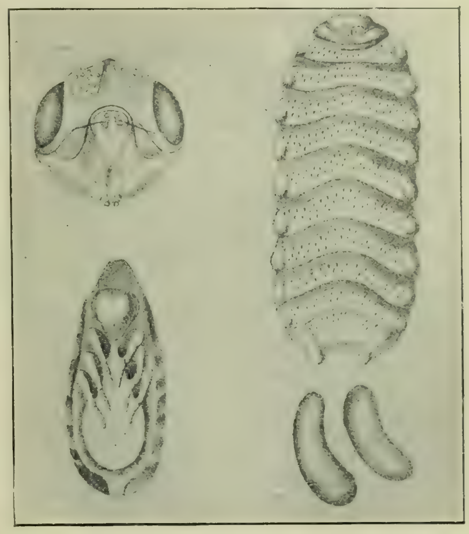

Fig. 1.
Head of Female Sheep Nasal Fly, larva, pupa in pupa case and ova (after Cooper Curtice).

The ova are very marked in form, curved and elongated, and white; covered with a sticky substance by means of which they adhere to the nostrils.

The larva shown in the figure enters when quite small the nasal cavities. This is done by means of the two small mouth hooks (Figs. 1 and 2).

According to Miss Ormerod the maggots also crawl up by "help of a pair of tubercles placed at the tail with which they can push themselves forwards, as well as by the adhesion of the underside of the maggot to the coating of the nostrils." In their young stage they are elongate and white, with no traces of true spines and about one-twelfth of an inch long; two anal spiracles can be seen; beneath there is a certain rugosity due to the incipient spines, which are white.

They moult their skin and enter a second stage and become a clear white in some specimens, semi-transparent and very thin skinned; the spines are more evident, but still small compared to the third stage; some of them show traces of brown tips. In the last stage the maggots are quite different in colour; some are dull brownish-yellow, others dirty brown, and darker bands appear on the back and the spines below become dark brown.

When full grown the grubs reach from 17 to 23 mm. in length. The position of these grubs is generally in the nasal passages, but now and again numbers crawl when young into the sinus of the skull (spaces in the skull). When mature they normally leave the sheep and fall to the ground. Some make their way under stones, tufts of grass, etc., others enter the soil and in all these positions they assume the puparium stage. The skin contracts, becomes smooth and hard, and dark brown in colour. In this puparium case, formed of the hardened grub's skin, the insect changes to a pupa and the fly may escape in from twenty to sixty days.

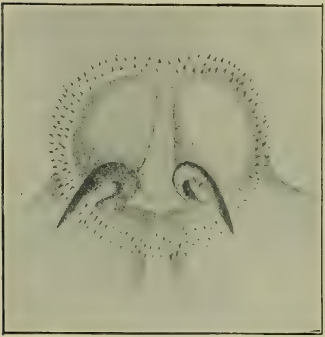

Fig. 2.
Head of the larva in the first stage, showing hooks (after Cooper Curtice).

The fly makes its exit by a round hole in the case, and escapes from under the covering or through the soil in a soft condition. It then crawls to some convenient spot, and its body and wings harden, and it flies off as soon as favourable weather comes, and is then ready to be fertilised by the male.

### *Positions in which the larvae occur.*

The majority of larvae occur in the nasal passages (so-called nasal fossae). Some, as shown in the photograph, reach the sinus of the head. Most occur in the frontal sinus. On two occasions I have found them in the nasal sinus. They have also been recorded from the maxillary sinus, the recesses of the turbinated bones, and in the core of the horn. Those found in such positions often cannot escape and eventually die in these spaces. In 1899, a specimen sent to the College showed the presence on opening the skull of a quite large maggot (practically full-grown) in the cerebral cavity. This may explain the term "grub-in-the-head" given to this attack. It has frequently been mentioned, but has been said to be impossible. It has occurred and it is quite possible for a very small larvae to penetrate the cribriform plate and so reach the cranial cavity.

The grubs I have found are especially noticeable in the heads from March to May. This is for the reason that they are then in the mature stage, and the prickly ventral skin irritates the nasal passages and calls attention to the annoyance. Miss Ormerod says they are most in evidence in May and June.

An interesting case was reported from Nonington on May 1st, 1905: the larvae were found in the windpipe and the air tubes of the lungs of a ewe. The correspondent, Mr. Crawford, stated that he "had lost several ewes and was anxious to know if the maggots were the cause of death." It was thought probable that this was only an isolated and abnormal case, and that although it had apparently been the cause of death of that particular ewe, the loss of others in the district showing "dropsical fever" was due to other causes.

### *Possible parthenogenesis in Oestrus ovis.*

A head sent me by Mr. Mead, of Molash, in April, 1903, contained no less than thirty grubs, most of these were quite mature, some ten, were however, quite small, and two or three were no more than 4 mm. in length. They proved undoubtedly to be young *Oestrus ovis.*

The only solution is that they had been produced parthenogenetically by the older grubs in the head. The specimen was received on April 7th, and it is quite unlikely that any flies were about at that early date.

I examined a similar case in Huntingdonshire in 1900, but there were only one small and two full-grown maggots present.

The presence of several sizes of grubs has been noticed before by Curtice, and he suggests that the fly may appear at any time of the year. This does not agree at all with observations I have made during the last twelve years in Kent.

### *Symptoms of attack.*

The chief signs of attack are the copious flow of mucus from the nostrils, sometimes clear, at others mixed with blood; sheep are also affected with vertigo, especially when the maggots occur in the sinus or the mucous membrane of the nose becomes much inflamed above. As the bots grow the irritation they set up by means of their prickly skin causes fits of sneezing (it is during these periods that the maggots are expelled).

Another sure sign is that of the constant shaking of the head from side to side, their heads held low down meanwhile. Where the grubs have taken up their abode in the pharynx, larynx and trachea violent fits of coughing occcur.

The symptoms to some extent resemble those of Sturdy or Gid, but the sheep never rotate in the same way.

### *Prevention.*

The prevention of this attack is by no means an easy matter. It is well-known that in certain meadows, and on certain hillsides, etc., sheep are more liable to this grub attack than elsewhere. In such cases if it is very abundant it might be worth while to keep the sheep off this land between May and late August. As far as our present knowledge goes it does not seem that the flies go very far from where they hatch out. Another point worthy of note is that the flies object to tar and creosote. Smearing the nostrils of sheep with such substances, or even grease, has been found to keep off this pest, by preventing her from depositing her young or ova if creosote or tar is used, and by killing the young larvae if grease is used.

The treating of the nostrils in a large flock by hand would be a costly and troublesome thing to do.

This can be done, however, in a less costly and troublesome manner, but perhaps not so effectually as by hand dressing. The plan is to place rock salt in boxes with a narrow depressed opening and smearing the boxes thickly all over with tar. The sheep in trying to get at the salt smear the tar over their nostrils, etc., and this keeps the winged enemy off and so prevents egg-laying.

This box may be made in two forms, one in which holes are merely made in the lid, not big enough for the sheep to get their nose through ; the other, which is best, with a slit at the bottom of a depressed lid. The sheep get far more tar on them when the latter form is used.

Where possible sheep should always have some shelter in hot weather. The Warble Flies will not go over water or into shade, hence if sheep have shelter of trees or any rough hovels into which they can run, they naturally protect themselves from this parasite. All affected sheep should be penned where they can be watched and any expelled grubs should be destroyed.

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## The Hen Flea (*Ceratophyllus gallinae* Schrank).

Two inquiries have been received relating to Poultry Fleas. The Fowl, Hen or Poultry Flea, formerly called *Pulex avium* Taschenberg, is now known as *Ceratophyllus gallinae* Schrank. At one time all bird fleas were thought to be the same species, now through the researches of Rothschild we know there are any number of species on different birds.

The fowl flea, nevertheless, occurs on sparrows, house-martins, starlings, blackbirds, robins, long-tailed tits and stockdoves, and has also been found on the long-tailed field mouse and the noctule bat.

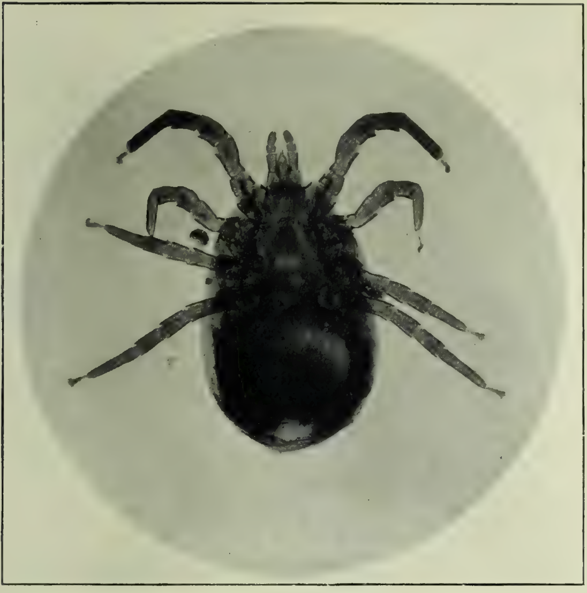
The fowl flea is not a permanent parasite : it goes to its hosts only to feed, and hides in the nests, etc., during the rest of the time. It is mainly nocturnal, but will feed during the day. They lay their ova or nits in the nests, on the floors, especially where there is dust ; the little pearly-white larvae seem to feed upon feathers, dirt, etc., and pupate in delicate silken cocoons. The ova hatch in from seven to ten days. The larvae mature in from ten days to five weeks. The pupal stage lasts ten to twenty-four days.

The fleas are provided with a piercing mouth and draw out quite a quantity of blood ; by so doing they cause considerable irritation, in consequence setting hens frequently desert their eggs.

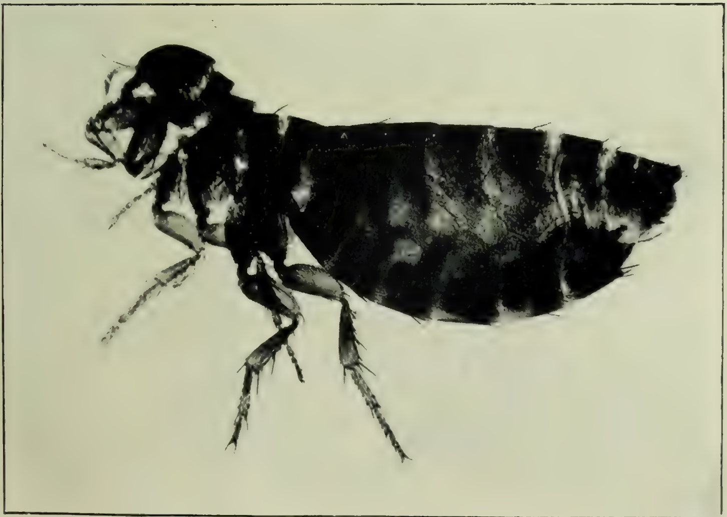
The best *treatment* for fleas in poultry-houses is to see that the nesting boxes, etc., are kept in a clean state, and the houses well white-washed every now and again. Setting hens should be put in nesting-boxes in which insect powder has been spread.

## The Red Hen Mite (*Dermanyssus avium* Redi).

Numerous inquiries have been received in recent years concerning the small mite popularly called the Red Hen Mite, the *Dermanyssus avium* of Redi. This small acarus is a perfect scourge to poultry and cage birds when kept in a dirty condition, and may also occur when kept under all proper sanitary arrangements. The mites attack the birds mainly at night and hence are frequently overlooked. They may be seen by the naked eye if looked for, but are very small. The general form is shown in the photograph reproduced here. The colour is usually dull yellowish-grey, but



The Red Hen Mite (*Dermanyssus avium*).



(Edenden.)

The Hen Flea (*Ceratophyllus gallinae*).

after feeding they become red. The adults (Plate II.) have eight legs, the larvae only six, the nymphs eight like the adult. They spend the day in crevices in the perches, in the nests and on the walls often hidden away in masses ; from these shelters they sally forth at night to attack the birds. They suck the blood, at least the females, for the males do not seem blood-thirsty. When very numerous they may be found on the birds during the daytime, especially where the houses are dark and damp and dirty.

They deposit minute white eggs in various shelters, where the mites hide, and we find ova, larvae, nymphs and adults all mixed up together. The eggs hatch rapidly, and the mites may mature in ten days.

They frequently cast their skins, and these exuviae form a grey mealy powder on the perches, etc., a sure sign of the presence of this pest in a fowl house. Man, horse and cattle may also be attacked by this acarus, and they have been known to attack the ears and nasal openings, and then cause very severe irritation.

*Prevention* consists in having the perches, nesting boxes, etc., readily moveable so that they can periodically be taken out and scalded or treated with some disinfectant. The walls should be frequently white-washed, and if the attack has been bad, sprayed all over with paraffin emulsion twice at an interval of six days. If this is done the birds are soon freed from the trouble.

# ANIMALS INJURIOUS TO FRUIT TREES AND BUSHES.

## The Raspberry Weevil (*Otiorhyr.chus picipes*) on Cherries.

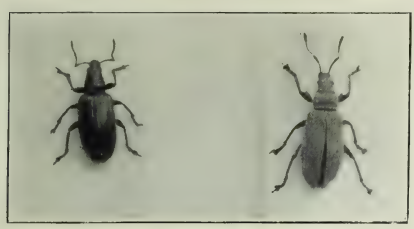
When visiting Mr. J. H. Crane's plantations on May 1st with Mr. Furley, at Oakhampton, Stourport, damage of a serious nature was pointed out done to the cherry trees in a large orchard.

Great numbers of the Raspberry Weevil (*Otiorhnychus picipes*) were found at rest on the branches, on the trunks, and still more amongst the long grass at the base of the trunks. There was no doubt that they were the cause of damage to the buds and foliage and fruit noticed in the previous year. It was soon found that they fell in considerable numbers when the trees were shaken. The beetles took up their day quarters almost anywhere on the trees, but preferred the shelter of some branch fork or rough bark on the trunks, and were always on the side of the smaller branches away from the direct light of the sun. They were perfectly motionless, and if touched at once fell to the ground and remained quiet for some minutes ; a few after some minutes turned over and rested where they fell, but the majority crawled away to shelter in the grass near the trees. Numbers were to be seen collected under old grease-bands put on for Winter Moth.

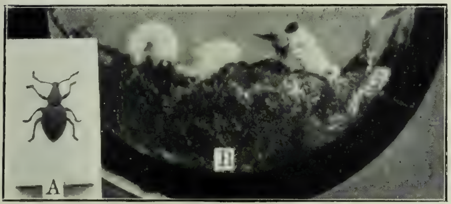
The bands were all removed and the rough grass was stocked away from the butts of the trees. Mr. Crane then had the trees well shaken and reported that many were killed in this way.

Later he wrote that he found that " by putting dry bagging round the butts of the trees catches quantities. The first morning as many as 105 were found in the bagging round one tree. Most of the trees had 30 to 100 in the bagging ; the second morning

PLATE III.



A.



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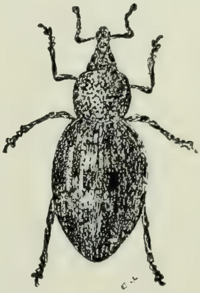

C.

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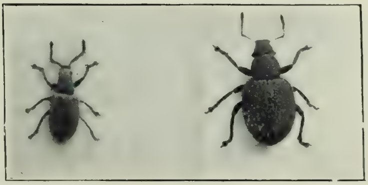


E.

A. *Phyllobius oblongus* and *P. maculicornis* × 3.
B. *Otiorhynchus picipes* and larvae (nat. size).
C. *Otiorhynchus tenebricosus*, 2. nat. size.
D. *Byturus tomentosus* or Raspberry Beetle (nat. size).
E. *Phyllobius uniformis* and *Strophosomus coryli* × 3.

not nearly so many." In a few days they were pretty well cleared out.

Further information gathered in the district showed that this Weevil is a well-known cherry pest there, and is locally known as the "Cherry Bug," on account of its smell when picking cherries in the early morning. The same beetle was observed in the College gardens this year (1909) where it was gnawing the young grafts of the apple. The rind of the grafts was eaten away in patches in a very similar way to the work of the Long Tailed Field Mouse, but of course easily told by the smaller damaged areas and by the absence of tooth marks. In this case the weevils were found sheltering during the day in the soil around the stocks. They were likewise destroyed by catching in sacking.

The damage done by these beetles to pear grafts was also reported from Kent, the rind being completely stripped off in some specimens.

## The Raspberry Beetle (*Byturus tomentosus*) attacking Loganberries.

The increasing damage done by the Raspberry Beetle (*Byturus tomentosus*) to Loganberries is very serious, both in Kent and Worcestershire, and to some extent in Somerset.

Mr. E. H. Holland, of Old Colwall, Malvern, wrote referring to his loss by this beetle last season, and mentioned the fact of the beetles coming out of the ground.

Mr. Hooper, of Pershore, also wrote in 1908, saying, "We had the Raspberry Beetle badly on our loganberries this year." I noticed it in small numbers there in 1905, and it was feared that it would become a serious pest in this fruit.

Mr. Coultup also reported damage near Canterbury, some of the fruits he sent containing as many as seven and eight larvae and in such cases were quite spoilt.

It was also doing damage in the Cheddar Valley in Somerset in exactly the same way.

It is a far worse pest in this fruit than in the Raspberry.

Not only does it attack the ripening fruit, but it works in another way in the beetle stage.

The blossoms are well-known to be cut off in raspberries, but another form of damage was sent me in loganberries. The beetles get into the open blossoms and eat passages around the cup and also the feathers, and thus the blossom is killed. The markings turn brown and then black, and become very noticeable. Mr. Martin has also noticed this in raspberries at Toddington, and I was able at home to watch them doing the damage, and found that most of the dead blossom was due to this unrecorded but common form of damage.

Spraying seems to have had no effect so far, at least where arsenical washes have been used. This is easily accounted for if the beetles feed mainly inside the cups, for an examination after spraying done very carefully showed that when the blossom was fallen—and it would not be wise to spray before—the anthers held off the fine spray and scarcely any lodged where the beetles fed. If this area can be reached in some way with some poison then the pest will lose much of its virulence. The blossom we must remember does not all open at once, so that *successive* sprays must be necessary in any case if the insects can be reached by this method.

Another method of treatment suggested itself to Mr. Craven, of Evesham, namely, of employing a very fine dust sent out with force. It is quite feasible that this would penetrate into the cups, and either finely-ground tobacco or arsenic could be employed mixed with some fine substance to form bulk and would probably be successful. But this again would have to be done many times. Anyway, such would be worth a good trial by growers as soon as this mixture has been perfected.

All that at present can be recommended is to forego a crop for one season by having all the young fruit picked off and burnt, such as is being done by Mr. Holland at Malvern. This, however, can only be of service where the logans are not surrounded anywhere near by raspberries or brambles, as the *Byturus* feed there, and so can invade the plants again.

A certain amount of good of course is done by ground treatment in winter to destroy the larvae and pupae in the soil, and also by the burning of all old and unnecessary canes.

It was also reported as very harmful to raspberries in June by Mr. Harnett at Newington.

Jarring at certain times, or sweeping with a net to collect the beetles does good, but at other times but few can be caught. This is because the beetles frequently get firmly wedged into only partially open blossoms, but if done on a day when they are fairly active, I have known the pest to be practically stamped out by this plan. The whole success depends upon the way and time the canes are jarred.

## The Raspberry Beetle (*Byturus tomentosus*) on Apple Blossom.

Although every year the Raspberry Beetle (*Byturus tomentosus*) may be found on Apple Blossom it was not until last season that any definite observations had been made concerning the damage they may do to the apple blossom. This was noticed by two correspondents. Mr. R. Foreman, of West Wood, Chelsfield, wrote on the 21st of May that he had five acres of Superlative raspberries which " had yearly been infested with the Brown Raspberry Bug, and this year before the blossom is fully out they have been ravaging the young blossoms of the apple trees that the cane is planted under—five year old trees."

Similar complaints were sent from near Exeter.

Observations made at Wye this year have confirmed this. The beetles feed on the tender tissue inside the blossoms just as they do in the case of the raspberry and loganberry, and leave behind small dark scarlike lines where they have gnawed the tender tissue around the sexual parts.

## The Apple Blossom Weevil (*Anthonomus pomorum* Linn.).

The Apple Blossom Weevil was again abundant in Worcestershire, Cambridgeshire and Kent last year.

Mr. Ballard, of Stockton, wrote in June saying it had been more abundant than ever there.

Mr. Small, of Bengeworth, also reported the great damage done by it, and further inquiries showed that it had been a general pest in Worcestershire. Mr. Getting also informed me that it was becoming a great nuisance in Herefordshire.

Whilst lecturing to the Wisbech Fruit-growers' Association, I learnt that it was causing a deal of loss in that part of Cambridgeshire. In certain districts of Kent, notably in the Maidstone and Sittingbourne area, it has been very plentiful for many years, but on the east side of the country it is still comparatively uncommon.

The life history is quite well-known, but so far nothing has been found to be of any special benefit in keeping its numbers down. Certainly where the thick lime and salt wash has been used it seems to have reduced it a bit. This is apparently by retarding the bursting of the buds, and so checking them from ovipositing. Jarring off the beetles one or two growers have found worth while, but over any acreage this is, of course, very difficult to do.

It does not seem to me that any spraying is likely to be of use, and some further experiments might well be made *re* trapping and banding.

The German banding paper referred to on page 120 is said to entice the beetles to winter in, and from what I see with other insects is well worth giving a trial.

So far no result of any benefit has been found by grease-banding, which was suggested at one time.

## Leaf Weevils (*Phyllobius spp.*) attacking Fruit Trees.

Reports and investigations made during the past year clearly show that the Leaf Weevils belonging to the genus *Phyllobius* damage fruit to a considerable extent. On the other hand, enormous numbers of these beetles may occur and apparently no damage is done.

Leaf Weevils, or Phyllobius Beetles, cause damage in three different ways. Firstly they may attack the buds, secondly the blossom, and thirdly they eat the foliage. I have not seen the latter taking place in fruit, but it frequently occurs in forest trees.

Mr. W. Berry, of Gushmere Court, Faversham, complained in May last of the damage these weevils were doing to the buds of "grafts." Another similar complaint was made from near Folkestone, and similar damage was traced to these beetles at Wye. In 1908, this form of damage seems to have been particularly noticeable. It was first thought to be due to ants by Mr. Berry, but was later found to be due to these coleoptera. The specimens sent me in 1908 doing this damage were all *Phyllobius oblongus*. The plan used by Mr. Berry to stop them was by grease-banding the trees after jarring the beetles off, and it was found they were caught in the grease bands in ascending again in considerable numbers.

Some other growers who have mentioned this attack to me say they find the best way is to send boys round to shake them off the grafts into tins of paraffin.

Observations made during the past year have clearly shown that these beetles may be caught in grease bands, as on hatching from the ground they first crawl up the trunks of the trees. As many as 200 were caught in one grease band.

### **The Apple Sawfly** (*Hoplocampa testudinea* Klug.).

The persistence of this pest was very marked during the past year in districts where it has previously been reported. Several new localities have to be recorded. On May 13th Mr. W. R. Pierce, of St. Dunstan's Nurseries, Canterbury, sent in apples already attacked by it. Quite tiny fruitlets showed the small perforations caused by the larvae eating their way in from fruitlet to fruitlet and most of them showed the mealy sinuous tunnelling on the outer skin, and even brown "frass" discoloration in this early stage.

Further trials of spraying with arsenate of lead gave similar results—that is, no benefit from the treatment. Owing to the uncertain action of disulphide of carbon in the soil in this country and pressure of other work, no further trials of it for coping with this pest were made, and moreover the cost appears to be far too great to make any further experiments worth carrying out. Hand-picking alone seems of any avail. Various sweet and poison baits have been tried, but in no case have any proved of the least value.

It was hoped that the sawflies might be enticed by sweet fluids or attracted to poisoned baits such as have proved so successful for Fruit Flies, but the only things caught have been various wild bees, especially species of the genus *Andrena*, and some hive bees.

The pest can, however, be kept down without any extra labour bill by having all attacked fruit collected and *burnt* during the thinning of the fruit. It is no use to do as one too frequently sees done—throw the small thinned out fruitlets on the ground.

There are several growers who aver that this Sawfly is no pest, but acts as a natural thinner. This is undoubtedly so in many cases, but when it thins out all the fruit, as I have often seen done, surely it is doing more harm than good. It is far better to have the fruit thinned by man, than to leave this process in such dangerous hands as the Apple Sawfly.

### **The Slugworm** (*Eriocampa limacina* De Geer).

Numerous letters have been received during the year concerning the Slugworm of the Pear and Cherry.

In August Mr. R. Mercer, of Rodmersham, sent the larvae and damaged cherry leaves and stated that " the attack is very severe, and over a fairly large acreage."

An inquiry concerning them was received in September from Mr. Henry Amos, of Sheldwich, where I was told that it was also doing some damage.

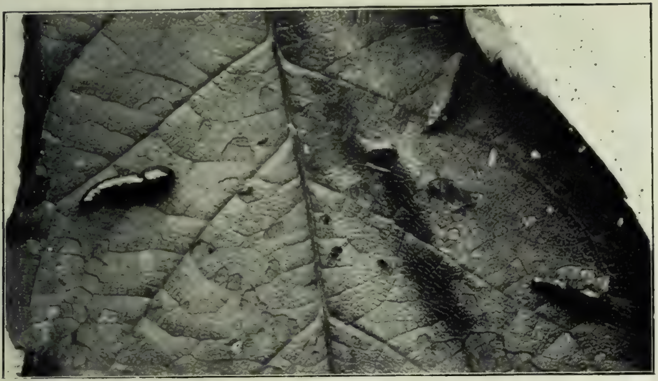
Specimens were also received from near Croydon, with a similar note. Mr. Levy, also wrote from Borden Hall, Sittingbourne, that they had appeared again in his trees, and were skeletonising the cherry leaves. Either spraying with arsenate or hellebore, or dusting with lime by means of a sulphurator will soon destroy them.

As a rule in most districts this sawfly does not occur until late in the year, and consequently the damage done is very slight, but now and again they occur in large numbers in August, and then by destroying the foliage they prevent the proper ripening of the wood.

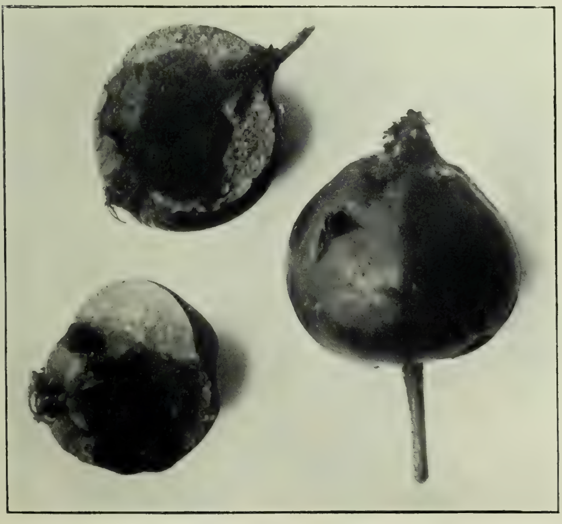
### **The Plum Sawfly** (*Hoplocampa fulvicornis* Klug.).

This sawfly has undoubtedly very much increased the last three years. It is probably wild in many districts, for it may now and again be found in wild prunes, and I have recently found it in

PLATE IV.



A.



B.

A. Slug Worms (*Eriocampa limacina*).
B. Apples attacked by Sawfly larvae.

the sloe. From this source an orchard may soon become invaded, perhaps only a few fruitlets here and there, which are not noticed at first. Then favourable conditions follow in spring during the egg-laying period, and the tree, or trees around, may show very marked loss; then in the next year it spreads much further afield if conditions have again been favourable.

It is undoubtedly advisable to take drastic steps to stop this increase in the beginning. I have found an attack has usually originated from one tree. When this is so it would well have repaid any trouble and cost to have *all* the fruit destroyed as soon as any signs of it appeared, and the ground dressed with Vaporite which will destroy the larvae as they fall, but which later will have little or no effect on them in the pupal stage. Failing this, a heavy injection of disulphide of carbon would be advisable as soon as most of the grubs have gone to earth, but such treatment is too costly over a large area. This pest was reported by Mr. Oswald Ellis, of Bramley, Surrey, as being found in June, 1908. Mr. Ellis informed me it was quite new to his plantations.

It was also reported again by Mr. Getting from near Ross, from Suckley, Worcester, by Mr. Best, from various places in Kent, and an attack was also noticed on Plums in Cornwall at Truro.

## LEPIDOPTERA.

### The Wood Leopard Moth (*Zeuzera pyrina* Linn.).

The larva of the Wood Leopard Moth, nearly full-grown, was sent on October 19th by Mr. B. Champion, from Mereworth, tunnelling into apple. Specimens were also sent from Norfolk attacking cherry, and from Huntingdonshire in pear.

One specimen sent showed very marked external signs of the caterpillars' presence, the bark of the branch, some one-and-a-half inches across, being markedly cracked and the sides swollen up in a very characteristic manner.

Several specimens were also received from around London.

This insect is never abundant, but a few do so much harm that they are readily noticed. The attacked branches should be cut right back and the larva or larvae in them destroyed.

As this caterpillar mainly works in small branches, which are killed by it during the winter, it is not worth while trying any remedy such as we can employ for the larger, longer lived Goat Moth caterpillar.

### **The Garden Swift Moth** (*Hepialus lupulinus* Linn.).

On November 21st, the larvae of the Garden Swift Moth were received from Mr. J. W. Gunn, of Swanscombe, who stated they were doing a great deal of damage to the Strawberries, and that they had tried soot and lime but with no effect. These caterpillars were unusually abundant in the winter of 1908, and were not only found in Kent and Worcester attacking strawberry roots, but all manner of garden plants. Mint is a favourite food with them. When these white caterpillars attack strawberries, they not only eat the fibrous roots, but they tunnel right into the main rhizomes, and soon kill the plant.

Two cases of the parasite, *Cordyceps eutomorrhiza*, were noticed. In one case the specimens came from Yorkshire, and the other was observed at Wye, quite 50 per cent. of the larvae being attacked, yet unfortunately they are as bad as ever in the same locality this autumn, and the beds had to be dressed with Vaporite to destroy them.

### **Vapourer Moth** (*Orgyia antiqua* Linn.).

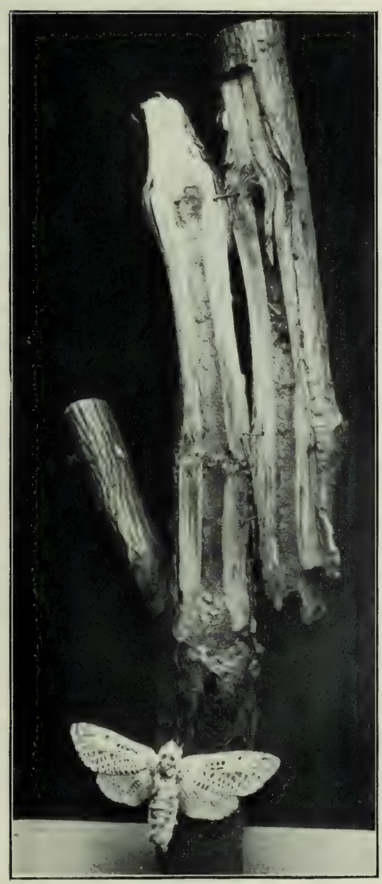
The ova of this moth were sent in for identification in November by the Rev. Francis Chambers, of Lested Court, Chart Sutton.

Specimens of ova were also received from Taunton, from Sevenoaks, from Northampton and Exeter.

This insect is not only found on fruit trees, but is often very harmful to Roses, Hawthorn hedges, and many forest trees form other food plants. It also occurs now and again on the Hop.

It has become of more importance than of late on account of its having been introduced into the United States on roses from France, and it is necessary for exporters to see that such material they send over is free from such pests. As pointed out, the American States now require a certificate from some recognised authority that the nursery from which stock is exported is free from Brown

PLATE V.



Wood Leopard Moth
and damaged Pear Shoot ($\frac{1}{2}$ nat. size).

Tail Moth and San José scale, and it is very probable that this pest will also be scheduled with some others.

The pest is figured here from my recent work on Fruit Pests, so that all growers have an opportunity of seeing what the insect in its various stages looks like.

The female is wingless, and places her ova on the cocoon from which she has hatched.

These egg masses should be searched for in nurseries in winter and all such destroyed, and whenever the very marked and beautiful caterpillars are seen they should be destroyed by spraying with arsenate of lead or collected by hand. Although it does not do any very serious amount of damage to fruit in this country, it is nevertheless harmful to roses and hawthorn hedges, and its possible inclusion in the American schedule makes it more important than ever that steps should be taken to rid ourselves of it as much as possible in nurseries especially.

Amongst other food plants reported last year was the Peach.

### The Magpie Moth (*Abraxas grossulariata* Linn.).

Although very general over Britain, the Magpie or Currant Moth (*Abraxas grossulariata*) is seldom inquired about, as it does not appear to cause very serious loss as a rule.

It was reported to me, however, last year by Mr. W. A. Nicholson, of Portobello, N.B., as having been very destructive in Midlothian that year.

In the London district it often does much harm to Currants, especially those growing against walls and fences in gardens, but in field cultivation it is seldom harmful.

The creamy white looper caterpillars with black spots and orange lateral markings are well-known objects, so also are the pretty slow-flying creamy white moths with black spotted wings and yellow and black spotted bodies.

The ova are laid in August and the young caterpillars, which are dark in colour, feed on the leaves in the autumn until they get too hard, when they seek winter shelter in any convenient spot, such as in holes in the walls, between the woodwork of fences and amongst dead leaves. Some also hibernate in the soil.

By far the best treatment where these caterpillars constantly occur and do harm is to spray the bushes in late September, so as to poison the young caterpillars before they hibernate, and so prevent the damage they do in the spring and early summer. This has now been tried for two seasons, and the pest has quite disappeared. During the past year nicotine was tried on the young larvae, and was found fatal to them just as it is to the young Winter Moth larvae.

### **The Green Pug Moth** (*Chloroclystis rectangulata* Linn.).

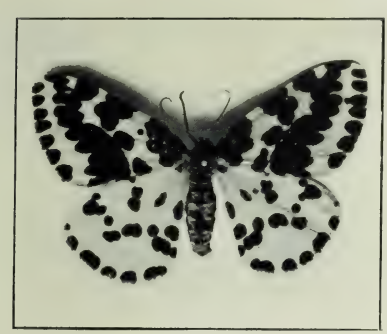
Numbers of the larvae of this moth were sent by Mr. D. L. Pattulo, of Longfield, on May 25th. Others were received in June from Sevenoaks, Worcester and from near Exeter. The caterpillars appear in small numbers in most orchards, but now and then in such numbers that they do much harm. They are yellowish green, with a rusty red line down the back, the divisions between the segments are dull reddish, and there is a yellowish-green line at the sides. The dorsal line varies in colour from dark green to almost purple. They are smaller than those of the Winter Moth when mature. They may be found as early as April, but it is not until May that they become noticeable, and most are ready to pupate by early June. The life-history does not seem to be properly understood, for we are told the moth appears in May, June and July, and the caterpillars in April and May. I have had the moths in July only. It is possible it may be double brooded.

The moth has a wing expanse of three-quarters of an inch, the front wings are deep rich green with dusky grey and brown wavy bars, and the hind wings have also a similar greenish tinge. The eggs are laid on the fruit trees, and there they remain all the winter. All the larvae I have kept have pupated in the soil in an earthen cocoon. The pupa is deep red at the tail-end, the thorax and wing cases being olive and yellow.

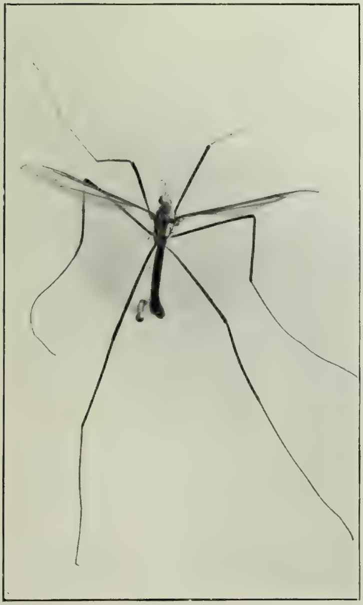
The caterpillars work in a very similar way to those of the Bud Moth (*T. ocellata*) by eating into the buds and blossoms of the apple and pear. They also gnaw the tender tips of the shoots and the foliage, and spin the trusses of blossom together.

An early spraying of arsenate of lead or nicotine wash will soon kill these caterpillars.

PLATE VI.



A.



B.

A. The Gooseberry Moth (*Abraxas grossulariata*).
B. The Daddy Long Legs (*Tipula oleracea*).

## Tortrix larvae on Apple and Plum.

Two complaints regarding the serious damage done by Tortrix larvae to apples have to be recorded. On May 8th, Mr. J. Brissenden of Wadhurst, wrote sending specimens of the larvae of *Tortrix ribeana*, which were defoliating his Apple trees. These trees, he said, had all been washed in the winter with $V^1$ wash.

*Tortrix pruniana* was also sent from Sevenoaks where it had been attacking Plums to a serious extent.

No trapping will do any good for the Tortrices, nothing but spraying; and for them also in their young stage I found that nicotine killed them, but not after they were half grown.

## The Vine Tortrix (*Tortrix relinquana* Hb.).

Specimens of the larvae of the Vine Tortrix (*Tortrix relinquana* Hb.) were received on December 3rd from Mr. A. E. Tickner, of Leigh, Reigate, with a note stating they were found in the bark of an indoor vine. It thus appears that this moth hibernates in the caterpillar stage.

## The Plum Fruit Moth (*Opadia funebrana* Tr.).

The presence of a small caterpillar or so-called "maggot" in plums is well-known, but is seldom inquired after by growers. The summer of 1908, however, witnessed quite a serious attack of this pest in some parts of Britain.

It appeared to have been bad on the Continent also, judging from the large number of maggoty greengages which were shipped here.

This plum insect was reported from Wye in August in Victoria Plums, which were quite ripe.

Numbers were sent by various correspondents from fruit bought in shops, in all cases derived from abroad.

The caterpillar, which is closely related to the Codling Moth, does not show its presence in the fruit until it is nearly mature, or the fruit is quite ripe. On opening the plum a wet mass of pulp and frass is found around the stone, and the caterpillar is soon seen. Its life-history has been pointed out, and all that need be repeated is that the caterpillars can easily be trapped in the same way as those of the Codling Moth, namely by tying a piece of sacking around the trunks of the trees close to the soil. The caterpillars spin up under this and can be collected and destroyed in the winter.

It may be mentioned here that in Germany a very useful paper banding is used, which can be employed for grease banding, and the catching or trapping of various pests such as the Plum Fruit Moth, Codling Moth, etc.

The paper is double, the under half being deeper than the upper, and between is placed a layer of crinkly paper such as is used for packing bottles, etc. This banding is tied on above and another string around the over-lapping single fold below. The larvae crawl up into the crinkly paper where they find ready shelter and spin up. These bands can be taken off in April before the moths hatch out and burnt with their consignment of hibernating larvae and insects, and at the same time used for greasebanding.

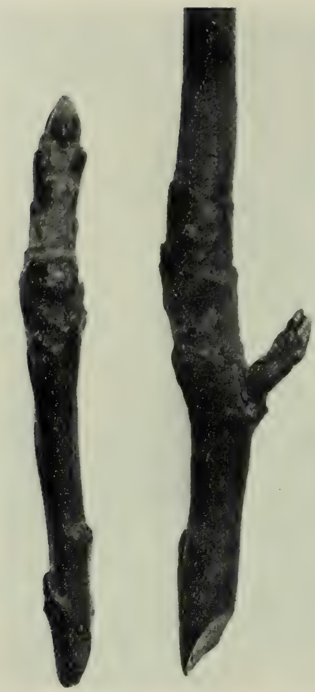
This paper can be obtained from Otto Hinsberg, Nackenheim-on-Rhine, the price being 1½d. a yard in thirty yard rolls; large quantities at 43 per cent. discount.

## **The Cherry Tree Borer** (*Semasia woeberiana* Schiff.).

This pest continues to be reported from the Sittingbourne area of Kent, and its distribution has now been traced down past Maidstone. Concerning it Mr. Lewis Levy, of Borden Hall, Sittingbourne, wrote me in January as follows :—" Nine trees seem to have died from this insect attack ; some have quite recovered. We had but very little last summer, and I feel sure that if directly castings were seen a fresh dressing was given, and the air again kept out, the pest would be stamped out. But the castings come at the time when we are very busy, and we do not close the holes often enough or properly enough." No ill effects have been seen in the cherry trees that have now been treated some years with the tar dressing. Another correspondent wrote from Teynham complaining of this insect.

Another method that may be tried for this borer is that adopted by American growers to check the Peach Borer, namely to bank

PLATE VII.



Apple Shoots showing winter quarters of the Pith Moth
(*Blastodacna hellerella*).

up mould around the stems some three feet up and leave it there from mid April to June. This mould prevents the first brood from laying their eggs for they seem to do so almost entirely on the trunk close to the ground. The soil could later be spread away from the trunks.

### **The Raspberry Shoot Borer** (*Lampronia rubiella* Bjerk.).

This insect was reported by Mr. H. Bolton, of the Bristol Museum, in May as doing damage in Somersetshire. I have dealt with this pest at length in a previous Report (*Journal S. E. Agri. Coll.*, No. 13, June, 1904), and in my recent work on Fruit Pests.* It has not previously been recorded from Somersetshire. Recently I found whilst visiting the Cheddar Valley that it is well-known there.

Smearing soft soap up the canes early in March is found to catch the larvae and seems to be the best plan for keeping this pest in check. Excellent results have also been obtained with arsenate of lead spraying during the past year, but the grease remedy seems to be best, especially if done twice, the second application some two or three weeks after the first.

### **Pith Moths** (*Blastodacna hellerella*, etc.).

This borer was again in evidence in many plantations in 1908, and fresh localities are being reported. Probably it has a wider distribution than was at first thought. Mr. Clive Murdock, of Linton, wrote in June saying he had found a good deal of dead blossom hanging down, and found in all cases a little red maggot in the stem. Specimens were also received from Hampshire and Sussex.

The treatment advised of pruning off the blistered shoots where the larvae winter has met with success, and as it only appears to occur on bush trees and espaliers, it can in that way be easily kept down.

All further observations made *re* spraying for this insect show that it does but little good, although there was some lessening of their numbers when arsenate of lead was used in September.

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* The Insect and Other Allied Pests of Orchard, Bush and Hothouse Fruits," pp. 416-419. (1909). 30s.

## **The Pear Midge** (*Diplosis pyrivora* Riley).

Numbers of inquiries have been received during the year concerning this serious pest. Experiments carried out with various substances for ground treatment have all yielded certain results.

It was reported by Mr. J. Thomas, of Bargain's Hill, Rodmersham, as being very harmful there. Mr. W. R. Garner, of the Orchards, Dyke, Bourne, wrote that several varieties were attacked, the crop, which set splendidly, was almost totally spoiled, and that this had been the case more or less during the last four years.

Mr W. Berry, of Gushmere Court, near Faversham, also complained of its damage, and similar complaints again came from Reigate and Hereford.

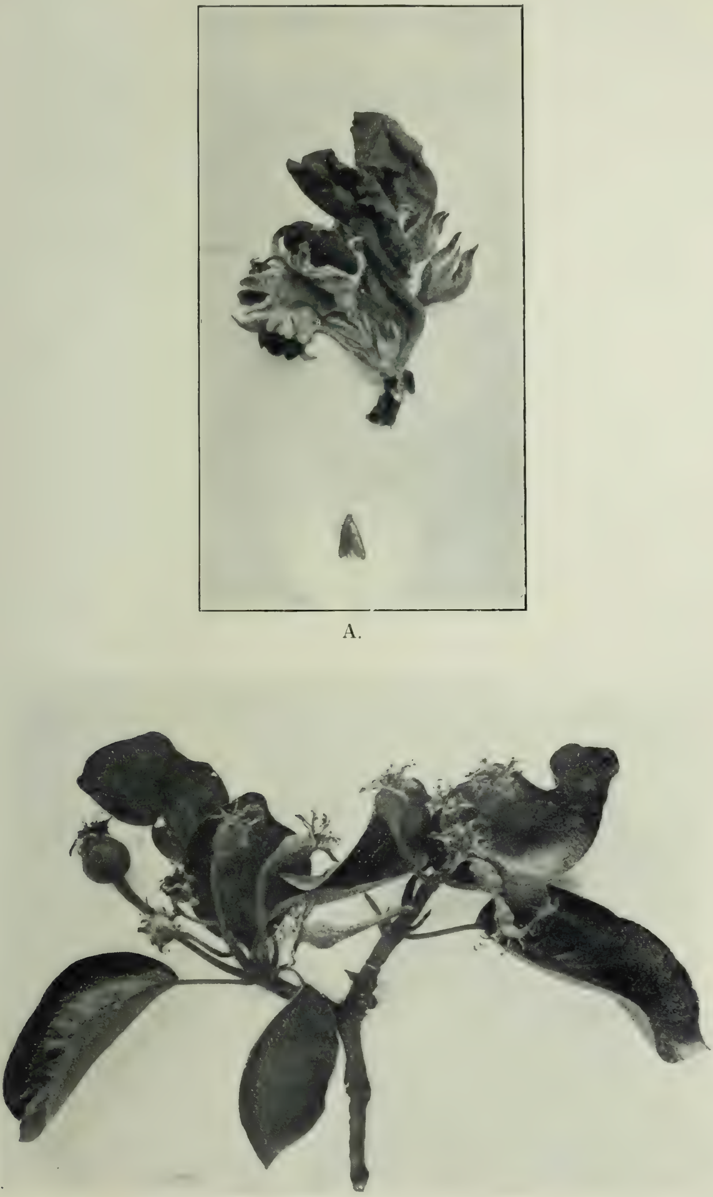
Nothing further in regard to treatment has been found out. Nicotine spraying, night lamps, and various washings have been tried without any result, except to show their uselessness. Experiments were made with various substances spread on the soil, and it was found that finely powdered hot gas lime and wood ashes, kainit, vaporite and waste acetelyne refuse with road dust (one part to twenty) were all partly successful in killing the grubs before they entered the soil, as they fell from the pears.

One interesting observation was made at Mr. Berry's plantations, namely two pears growing out well and forming flesh, contained imprisoned larvae. The same was noticed at Mr. Robert Amos' at Perry Court in July, when one large pear somewhat deformed was found to contain eight larvae which could not possibly escape.

## Cecidomyia larvae in Mummy Plums.

Mr. E. P. Whiteley sent in February some mummified Czar Plums which had been hanging on the trees all the winter, which contained a number of small red larvae. These proved to be larval *Cecidomyidae* belonging to a group at present not worked out or named, which are well-known to feed on fungi, especially Mildews and Moulds. Various species may be found, some feeding on the Rust of Wheat, others in great numbers on the Powdery Mildew of the Apple, others on the European Gooseberry Mildew, and one on the Hop Mould. The latter I described in my Report for 1904-5.

## PLATE VIII.



A. The Pith Moth (*Blastodacna hellerella*) and damaged blossom spur.
B. Pear fruitlets enlarged by Pear Midge.

# PLATE IX.

A.

B.

C.

D.

E.

A. *Schizoneura ulmi* on Currant root.
B. Osier damaged by C. the Osier Weevil (*Cryptorhynchus lapathi*); D. larval Fever Flies E. (*Bibionidae*).

Although they feed upon these parasitic fungi they are so small and feed so slowly that even large numbers do little or no good.

## Bibionidae, or Black Flies.

Large numbers of specimens of these flies both in adult and larval stages have been received during the past year.

One grower, Mr. W. R. Pierce, F.R.H.S., of St. Dunstan's Nurseries, Canterbury, sent a box full of *Bibio marci*—St. Mark's Fly—in the middle of May with a note that they were simply swarming on gooseberry bushes, and that the same wash he was using for Red Spider killed them.

Another grower near Wisbech sent the same species and said they may be harming the blossom.

These flies, of which there are several common species, *Bibio hortulanus* being perhaps the commonest, do no harm in themselves, but their grubs or larvae are destructive to the roots of many plants, such as strawberry and hop and most garden plants.

The grubs either occur in masses or in colonies in the soil, and resemble small Leather-Jackets, but can be told at once from them by having blunt, finger-like processes on the body. Lime is distasteful to them, but Vaporite I have found best to destroy them in the soil.

## Leather Jackets in Loganberries.

A new pest to Loganberries was reported in May by Mr. James Mason, of Worcester, and recorded in my recent work on Fruit Pests.

Mr. Mason wrote saying, " I have just planted 1,000 rooted loganberry tips, and they are being eaten off by the enclosed grubs, I find six or so near each root and fear the loss will be very great." The larvae proved to be Leather Jackets, and eventually hatched into the Common Crane Fly (*Tipula oleracea*).

This new pest to this valuable, but much harassed fruit, is likely to be of occasional occurrence, and it is well to see that all land in which " tips " are planted has been cleared of them beforehand.

There is no doubt from experiments I have made that this can be done with two preparations sent me, namely, Vaporite and Fumite, if it is done thoroughly.

Both must be well worked into the soil with a prong hoe, and as evenly spread as possible. It does not appear that the fumes of any of these ground insecticides are fatal at more than a few inches, and it seems that contact or very close proximity is necessary, and then soft-bodied larvae as the Tipulid larvae and Weevil larvae are killed by them.

They must in this and many other cases be used to kill the insects on the land some two or three weeks before planting up, as it has been found that the tips of loganberries are destroyed.

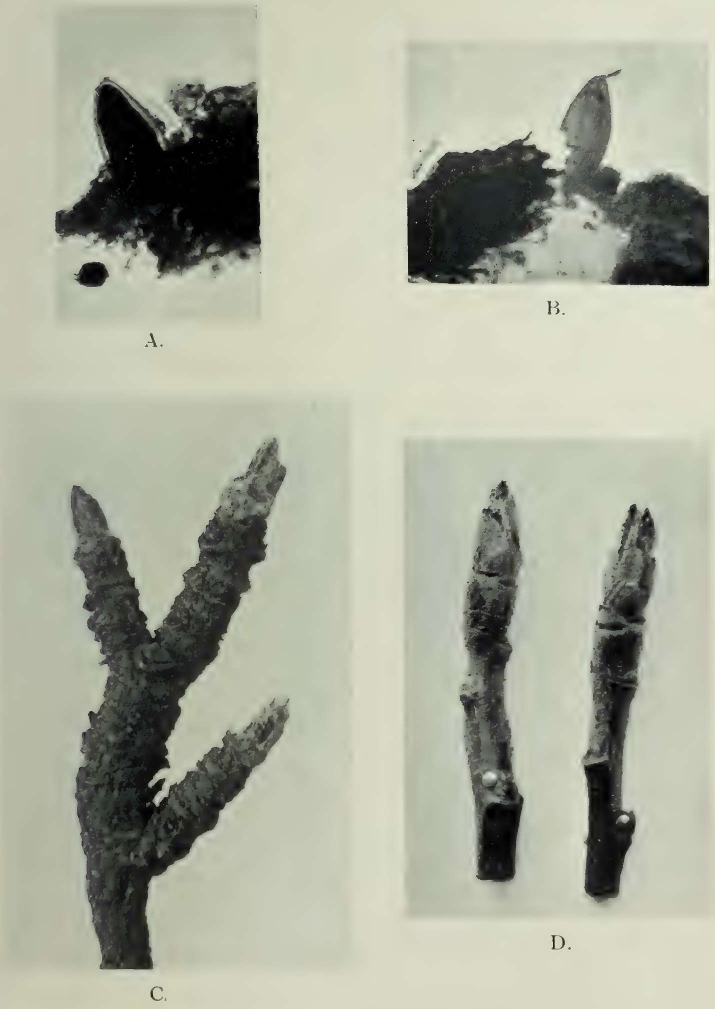
### **The Apple Sucker** (*Psylla mali* Schmid.).

Reports during the past year have confirmed the good results obtained with the lime and salt wash both in Worcestershire and Kent. Where this treatment was not carried out I saw very severe attacks of this insect.

Fortunately in many places where this has been tried rows of check trees have been kept. I mention this on account of the following note sent me by Mr. Ballard, of Stockton, as follows: "The Psylla have almost disappeared here on many trees which have never been washed." As no natural enemies of the Apple pest have yet been found in this country this is a very curious incident, particularly as in most other parts of the same county it was abundant where no treatment had been employed to check it. This insect has been bad in the Wisbech district, and several reports reached me of its damage in Lincolnshire and Surrey, and one report reached me from Newport, Shropshire, twigs sent being covered with the ova. The lime and salt treatment together with a single spraying of nicotine wash as soon as the blossom has fallen is now known to completely check this insect, so that its presence need not be feared as formerly, if one only takes the trouble to destroy it.

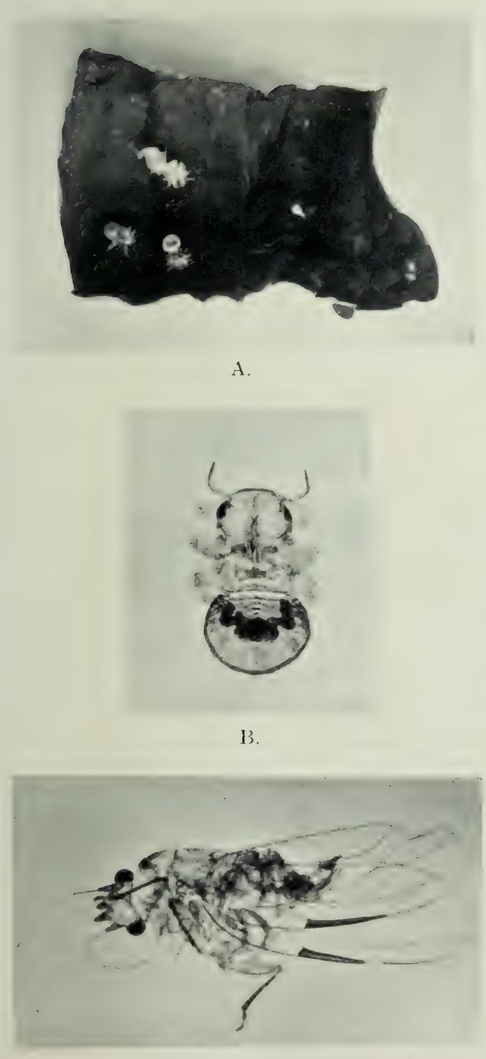
The nicotine wash as recommended by Mr. Spencer Pickering in every case did good, and if sprayed when the blossom trusses just open out it will cope with a combined attack of Sucker, Aphis and Winter Moth, and is thus undoubtedly the most economic

PLATE X.



The Apple Sucker (*Psylla mali*).
A and B. Ova greatly enlarged; C. Ova on Apple Shoot; D. Young larvae on buds.

PLATE XI.



C.

THE APPLE SUCKER (*Psylla mali*).

A. Nymph skins (enlarged); B. Nymph (greatly enlarged); C. Adult (greatly enlarged).

wash to use in spite of the cost (*vide* paper on experiments with nicotine, p. 134).

Great numbers of the winged adults were caught in July and August in bands of Tanglefoot on trees at Wye, as many as seventy being caught in two days on one band.

This pest I find is common in some parts of Middlesex, but has not been generally recognised. Further experiments were made with lime and salt in February, as some growers reported that the salt had scorched the buds at the amount recommended, namely 30lbs. to the 100 gallons.

Various quantities of salt up to 40lbs. to 100 gallons were tested, and no harm whatever resulted on several varieties of apples. The same results were obtained as before, namely that with salt the lime does not flake off as badly as without it, and I cannot do otherwise than continue to recommend from 20 to 30lbs. to the 100 gallons.

### The Currant Root Louse (*Schizoneura ulmi or S. fodiens*).

This currant pest was sent in August by Mr. D. Pattullo, of Longfield, where it was attacking the roots of Red Currants.

Since my last Report Barsacq has shown that Buckton's *Schizoneura fodiens* is only an alternate race of the leaf-curling Elm Aphis known as *Schizoneura ulmi*. As the latter swarms on elms in most districts it will be seen how impossible it is to keep this insect off the roots of the currants. Great care should be paid, however, to seeing that the currant roots are clean before any fresh stock is planted, as it might in that way be introduced into a locality where it is not endigenous to the elm.

Currants showing a backward growth may be examined, and if the parts below ground are very badly attacked, the soil may be soaked with warm paraffin and soap, not more than 1 gallon of paraffin to 50 of water and 2 lbs. of soap.

### The Green Fly (*Aphis grossulariae* Kaltenbach) on Gooseberries and Red Currants.

Little attention has been so far paid to the Aphis attack on gooseberries. Mr. H. J. Obec, of Maidstone, wrote in January for information how to deal with the persistent attack of "Green

Fly " when it comes on gooseberries. Mr. Best also wrote inquiring about it from Worcester. It also, I have learnt, occurs in the Wisbech area, and also in Surrey, Hampshire, Norfolk, and I have seen attacks in Devon and Somerset. It probably occurs widely over the country. It has been taken formerly for the leaf-curling Currant Aphis, *Rhopalosiphum ribis*, but is quite distinct. It causes the top shoots to become dwarfed and the leaves curled up in a tight mass. When the leaves fall, deformed shoots are the result, and these bear some resemblance to American Gooseberry Mildew, and have undoubtedly led to errors in support of the theory that this fungus was of old standing.

The attack was first noticed last year in June. A few winged lice appeared, and in a few days a dense mass of lice covered the tips. In less than ten days the lice spread on to the young leaves, and these soon curled up and a dense growth resulted. The dark green coloured lice were densely packed together and collected both on the tip of the shoot and under the curled young leaves. The result soon showed: the leaves became dull, then brown and shrivelled up and then the aphis became winged and disappeared. I thought I found the aphis on Wurtzel, but I am not certain, and unfortunately none were preserved at the time. In any case it seems to leave the gooseberries and does not occur again until the spring.

Exactly the same attack occurs on Red Currants, and I cannot separate the species. The same dense tuft of curled leaves and the same contorted shoots are seen in the winter. It disappeared from the Red Currants at the same time it left the gooseberries. Where it goes to we do not know.

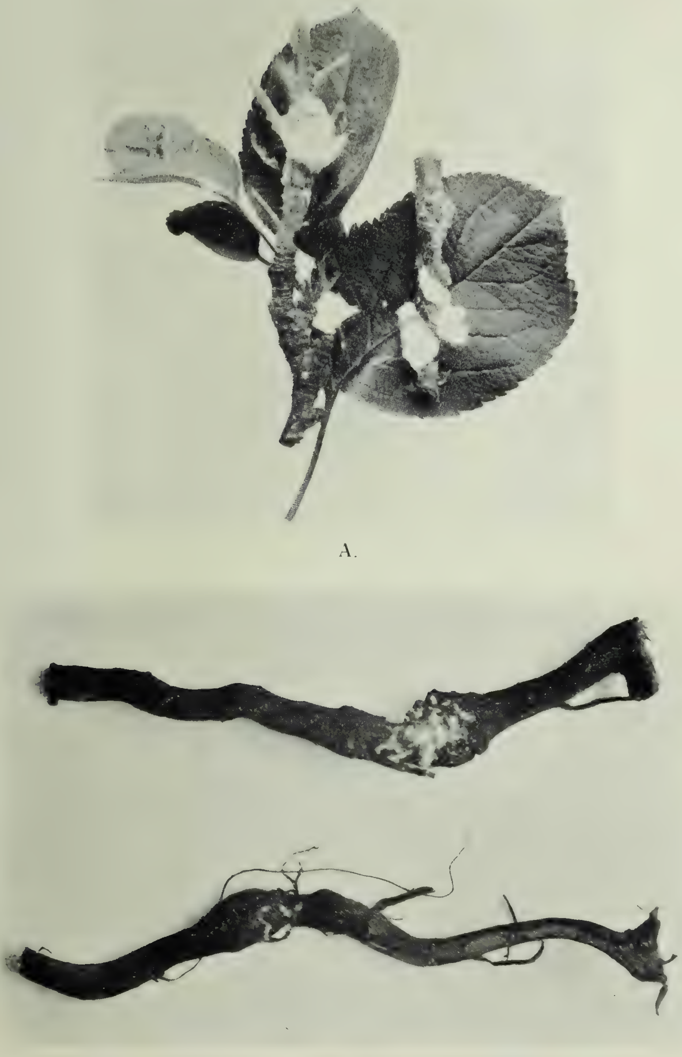
The slaty to olive green colour of the wingless aphides, their dense clustering nature separates it at once from the two well-known currant aphides (*S. ribesii* and *M. ribis*).

Late spraying is no use as few of the insects are reached, I find, even with nicotine wash. But if the bushes are sprayed when we see the few dark green lice on the tips, then it can more easily be controlled.

## Fumigation for Woolly Aphis.

The process of fumigating nursery stock with hydrocyanic acid gas found so successful by Mr. Lonunsbury, Entomologist to

Plate XII.



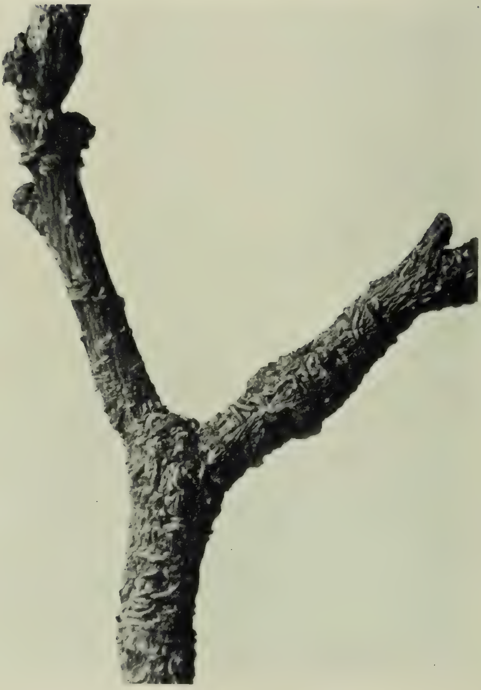
A.

B.

The Woolly Aphis.
A. on shoots ; B. on roots.

Plate XIII.

Woolly Aphis on shoots near ground descending to the roots.



The Mussel Scale (*Lepidosaphaes ulmi*).

the Cape Government, has been repeatedly tried, and found to work as well here as in Africa. There is no doubt that at the strength recommended it is fatal to not only all living insects, but also their eggs. That a small amount of scorching takes place at the tips in certain varieties has been shown the last two years, but this obviously does not matter. Besides Mr. Wood, of Swanley, who treated some thousands of stock and found this method most successful, Mr. Ivo Neame, of Faversham, writes, " There seems to be no doubt that it is effective ; some of the young trees I put out were badly attacked on the young wood, and the insects can now be seen hanging on by their beaks quite dead."

Several other growers have written reporting the success of this treatment.

## Mussel Scale and Woburn Wash.

In all cases that have come under my notice the Woburn Winter Wash of paraffin and caustic soda has proved successful in combating the mussel scale, both in Kent and Worcester. It works no more successfully than strong paraffin emulsion, but it is quicker in its action.

It is of interest, therefore, to report the following from Mr. Moore, of Shelsley Beauchamp, Worcester : " I have Mussel Scale very badly on some apple stocks. I have twice within the last eighteen months applied the caustic-soda-paraffin emulsion in the best possible manner, but with poor results." In view of the general satisfactory reports sent in of this treatment, it is difficult to explain this failure.

## The Nut Bud Mite (*Eriophyes arellanae* Nalepa).

More attention is being paid to this mite than formerly, which looks as if growers were beginning to consider it of some importance. Specimens were received from Mr. George Arnold, of Branbridge, Paddock Wood, in January, and from many other correspondents.

The mite is frequently thought to be the same as the Big Bud Mite of the Currant, but it is quite a distinct species. I have frequently tried to infect currants with it, but without result. It does not increase as rapidly as the currant species, and as far as I have observed it only attacks the leaf buds. I am not aware if it attacks the female blossom buds at all. Hazels in the hedgerows and wood were badly attacked by it last year, but this year they show few signs of its presence. As infection undoubtedly may come from wild nuts, it is well not to plant up nuts near them, as there is no remedy known.

### **The Plum Leaf Bister Mite** (*Eriophyes phloeocoptes* Nalepa).

In 1904 I noticed the frequency of this acarus on plum leaves at Evesham, but the growers I spoke to at the time did not consider it of any importance. It has turned out to be so, however, in one locality in Kent. Writing in June last year, Mr. Wm. Chambers, of Shepway Court, Maidstone, said, " A year or so back we had it only on a few trees ; now it is general all over the farm—only taking to the Prune and Plum. Trees that get it very badly have little or no fruit."

These gall mites form small pale grey, yellow or green wart-like blisters on the upper surface of the leaves of plums ; the galls may be somewhat hollow beneath and hairy : a few show a rosy hue.

The minute transparent mites breed in the galls all the summer, and pass the winter just as does the Pear Leaf Blister Mite, in between the bud scales. No experiments have been made with regard to checking this species, but I found that an allied form, *Eriophyes padi* Nalepa, which occurs on Damson, Sloe, etc., can be checked by winter spraying with lime, salt, caustic soda and sulphur wash.

### **The Pear Leaf Blister Mite** (*Eriophyes pyri* Scheut).

During the past year there was considerable increase in this pest, which has been continued in greater virulence during the present spring and summer. One very marked feature is its persistent spread on to the fruitlets.

Writing on the 27th of May, 1908, Mr. H. A. A. Dombrain, of Lenham, said it was worse last year, and is now getting on to the fruit as well as blistering the leaves. The variety attacked was the William, and most marked on a south wall. Two days later he found the disease appearing on other trees about a hundred yards away.

It was also reported from near Sittingbourne by Mr. F. Cleaver, of Chalkwell, in October; from near Market Drayton in Staffordshire, where wall pears were absolutely ruined by it; from near Exeter and near Totnes in Devonshire, and elsewhere.

I have already dealt fully with the life-history of this pest, which has now assumed such a serious nature, especially on wall fruit.

The treatment, which so far has been found to keep it in check, is winter spraying with the lime, salt, caustic soda and sulphur wash, followed by an early spring dressing of paraffin emulsion, and this may with advantage be used also after the fruit is gathered in the autumn.

Unless the treatment is done thoroughly it is no good, and the disease will continue until as I have seen this year, the trees die under the attack.

## MAMMALIA.

### Damage to Fruit Trees by Voles.

The photograph shown here illustrates an unusual form of damage done by Voles to fruit trees.

Two specimens were received in February from Mr. T. Wood, of Pedham Place, Swanley. Both trees were Worcester Pearmains. The damage was thought to be possibly due to Moles. Moles, of course, are purely insectivorous feeders and earthworm devourers.

Both the Bank Vole and Field Vole will attack the bark of fruit trees above ground, but the damage done below the surface is due to the Field Vole or so-called Short Tailed Field Mouse (*Microtus agrestis*). This rodent is found all over England, Wales and Scotland (except in Lewis), but it is unknown in Ireland. It is undoubtedly the most harmful rodent to the farmer and forester, and it may prove so to the horticulturalist and fruit grower. As is well-known, owing to its enormous powers of reproduction, it sometimes increases to such proportions that it becomes a veritable plague. Vole plagues have been numerous in the British Isles. The first on record was in 1580, when in the hundred of Danesey in Essex the roots of all the pasture grass was destroyed by these pests. Another large " plague " was in 1813-1814, which extended over the Forest of Dean and the New Forest. Upwards of 30,000 voles were destroyed in the Forest of Dean, and 11,500 in the New Forest. Again from 1874-1876 a similar " plague " occurred in Wensleydale, etc., and the hill pastures of the Borderland and parts of Yorkshire were quite destroyed.

In 1892, an alarming number appeared in the south of Scotland, where between 80,000 and 90,000 acres were affected from the northern boundaries of Dumfriesshire, east of Thornhill and the north-west of Roxburgh ; Selkirk, Peebles, Lanark and other places were affected at the same time.

The Field Vole feeds on all manner of vegetable substances, such as seeds, grass, herbs, leaves, roots, beech mast, nuts, corn, potatoes, turnips, clover, bark of all trees, and as recorded here, the bark and sap wood of the trees below ground and the larger roots. They are gregarious, living in pairs, and when in numbers they so tunnel the soil that their burrows are linked together.

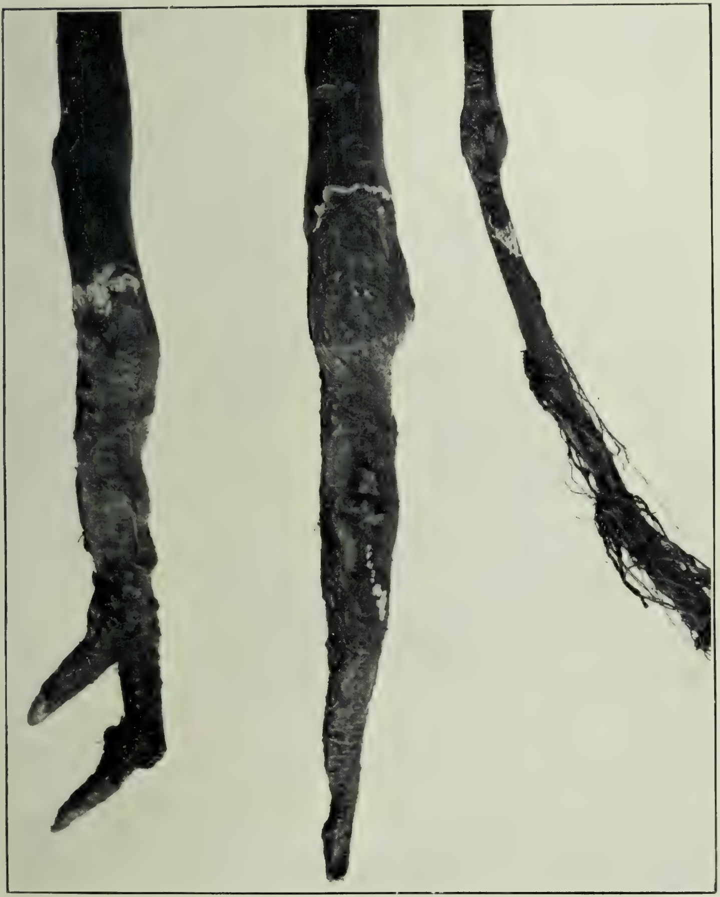
Under certain conditions, conditions we do not understand, they may multiply in enormous numbers and so plagues of them occur.

They produce their young in nests in their tunnels underground, from one to two feet below the surface, lined with soft grasses and moss. From four to eight young occur at a litter and these may be found in April onwards, a female having often as many as seven litters. It is said the spring young are ready to breed by autumn.

Their appearance in a fruit plantation should at once be followed by trapping, as they may evidently do much damage. Destruction on a large scale is very difficult : digging holes for them to fall into here and there has met with success. Where their tunnels are seen in numbers injections of disulphide of carbon have proved very successful, but expensive.

Excellent results have been obtained with " Virus " ; in other cases it has completely failed. In 1909, I experimented with a " Virus " on the market, and the voles died off in great numbers. Last year I used the same Virus and it had no effect. At present it does not seem we can rely on this method of extermination.

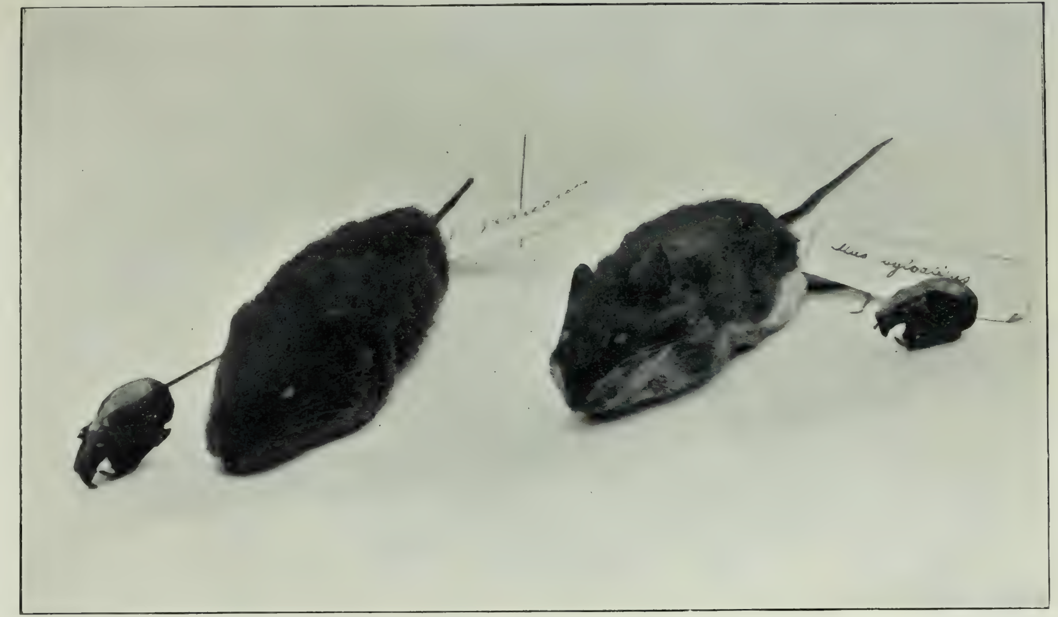
Plate XV.



(*Edenden.*)

Apple roots eaten by the Field Voles (one-third nat. size).

Plate XVI.



The Field Vole and the Long-tailed Field Mouse.

Hawks, owls, foxes, stoats, weasels, and rooks and crows feed upon them in numbers and keep them down. It is perhaps the ruthless destruction of their natural enemies that is one of the causes of their too often sudden increase.

## GENERAL.

### Grease banding Fruit Trees.

Two sets of experiments have been carried out in connection with grease banding.

One to test the relative lasting powers of various greases, the second to see what insects are to be caught in the grease bands.

The results of the former cannot be published, as all those greases used were proprietary articles. Some thirty different kinds have been tested, but the final results will not be issued until next year. Some general results gained were, however, interesting as showing the relative value of greases.

They varied as follows :—Grease (*a.*) banded on January 15th, a thin watery grease which even put on thinly in a few days had run down the paper and two feet down the trunks. By February 3rd this grease was quite dry and caught no more insects.

(*b.*) A thick white grease of medium quality used the same day, held well on the bands, exuded globules of liquid and remained useful until March 1st, then gradually hardened off until by March 20th it was quite caked over and passable to any insect.

(*c.*) A clear, shiny, very sticky grease, which has remained in the same condition until September 5th. No running in heat, no hardening in frost. In rainy weather it remains equally sticky, but becomes opalescent. It appears as if it would remain sticky for some months to come. It resembles Bird Lime.

(*d.*) A black grease Raupenleim or Insect Glue. This type remains sticky well, but does not seem sufficiently sticky to hold insects, nor does it attract them as do the light greases and shiny, clear greases.

A number of these insect glues have been tried, and the results have been unsatisfactory.

The importance of the lasting power of a grease seems to be the main thing to aim at, and this seems to be found in the last named case. If a grease can be turned out at a *reasonable price* which will only necessitate one application requisite for Winter Moths, and which will last long into the summer, it will be a boon to all fruit-growers.

## Insects caught in grease bands.

The following insects were taken in ten grease bands on Apple and Plum trees at Wye between January 15th and June 5th :—

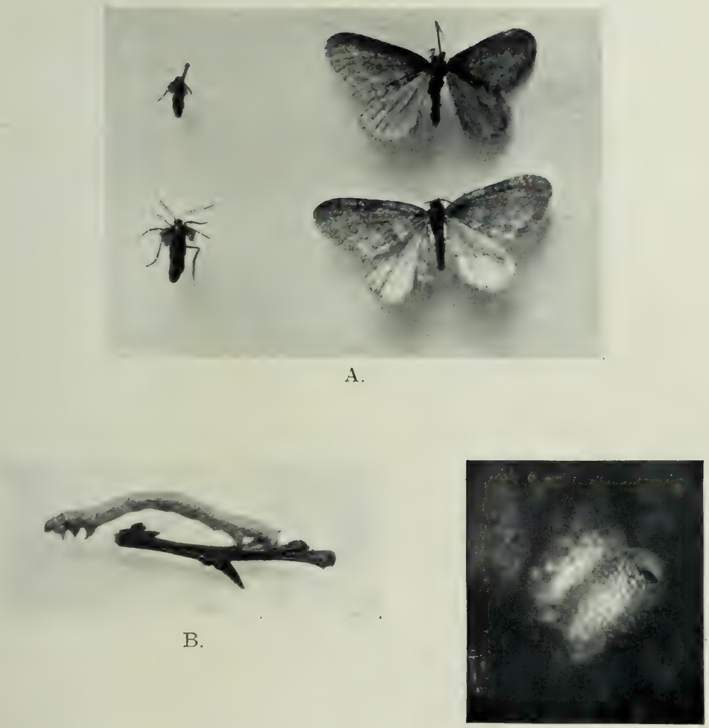
### Adults.

1. *Lepidoptera.* Winter Moths (♂ and ♀'s) twenty-two, the last February 19th ; Early Moth seventy ♂'s and twenty ♀'s ; Pale Brindle Beauty, seven ♂'s, one ♀ ; March Moth, one ♂, two ♀'s ; Flat Bodied Moths (Depressaria), twenty-four.
2. *Coleoptera.* Green Leaf Weevils in large numbers in late May and June ; *Apions* (2 species) twenty-five ; other *Phyllobius* Weevils, forty. One small Longicorn sp. ? Click beetles forty.
3. *Hymenoptera.* Several honey bees.
4. *Diptera.* Mosquitoes (*Anopheles maculipennis*), three; *Culex pipiens*, ten ; *Chironomidœ* in great numbers ; *Stomoxys calcitrans*, seventeen ; Winter Gnats (*Trichocera*) in great numbers ; *Psychodidae* or Owl Midges in numbers.
5. *Hemiptera.* *Nemocoris* (2 sp. ?) seven ; Winged ♀ Aphides in numbers in June sp. ? *Psylla mali* hundreds of winged ♂'s and ♀'s.
6. Julus worms, seventy.
7. Woodlice, twenty-four.

LARVAE.

Winter Moth, 300, in late May and early June on three trees ; Pug Moth, three ; March Moth, seven.

PLATE XVII.



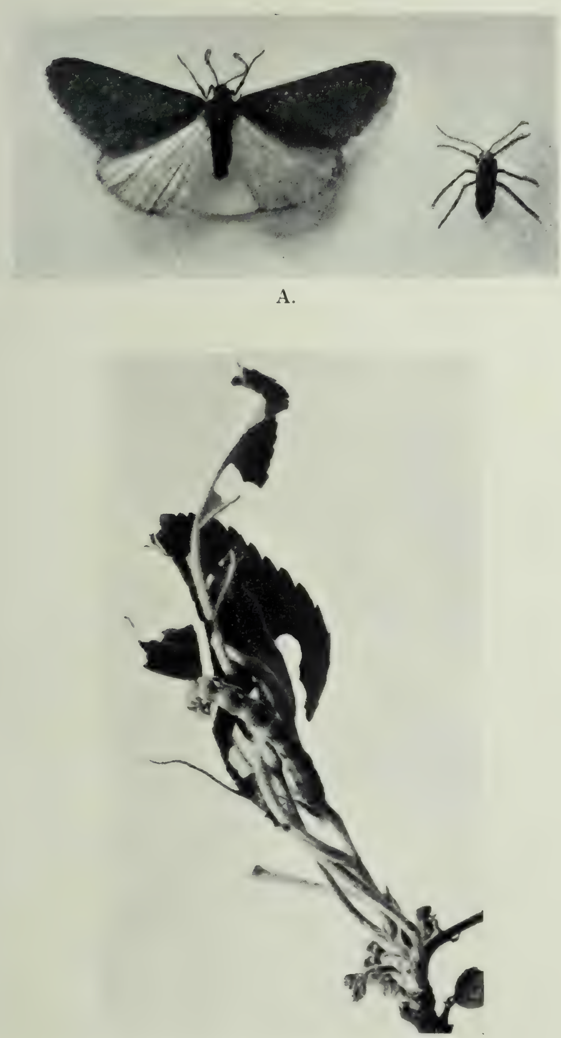
A.

B.

C.

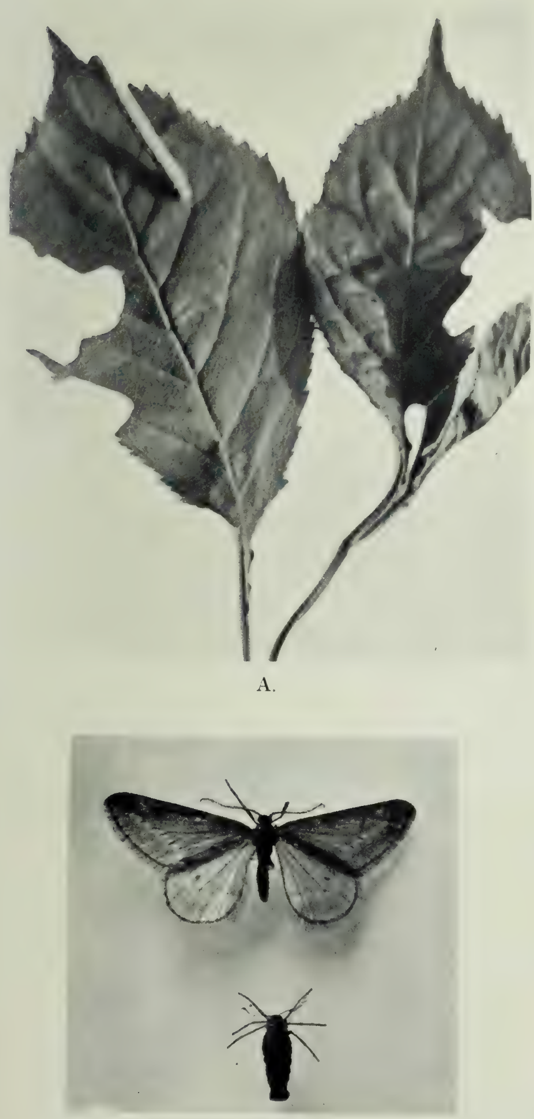
THE WINTER MOTH.
A Females and Males ; B Larva ; C ova (greatly enlarged).

PLATE XVIII.



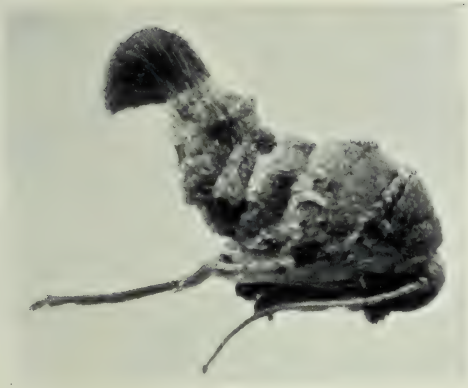
A. Male and Wingless Female of the Mottled Umber Moth and larva B.

Plate XIX.

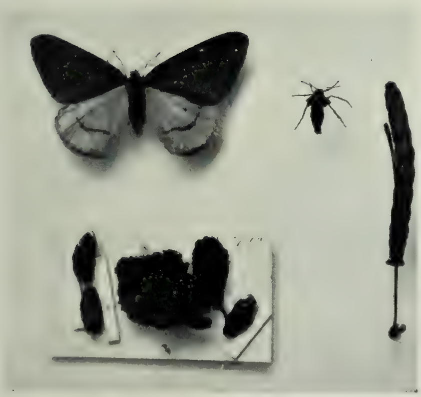


Larva (A.) and Winged Male and Wingless Female (B.) of the March Moth.

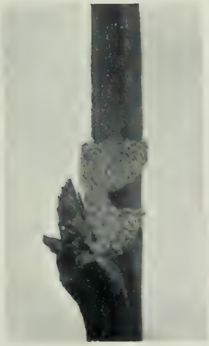
## Plate XX.



A.



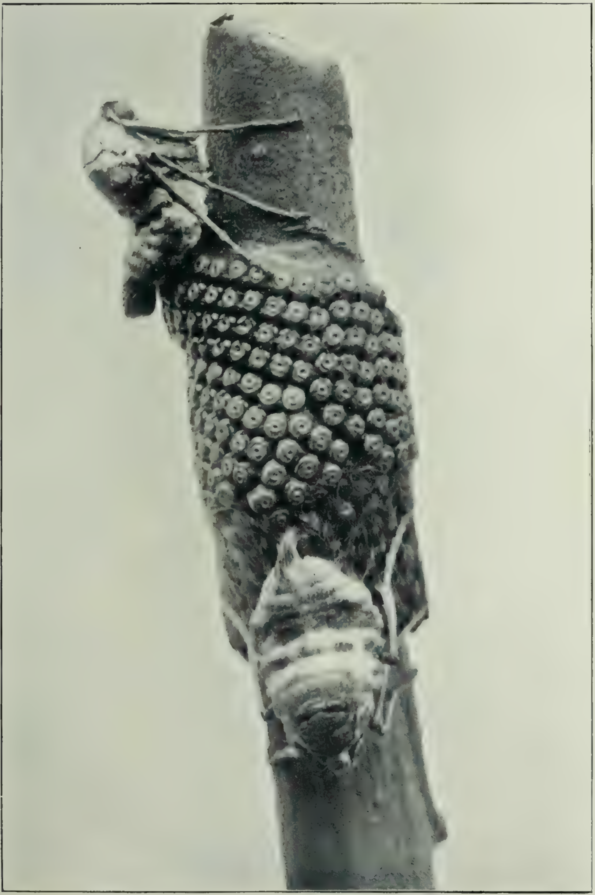
C.



B.

A. Wingless Female March Moth (greatly enlarged).
B. Egg mass (nat. size) of March Moth.
C. Stages of the Early Moth.

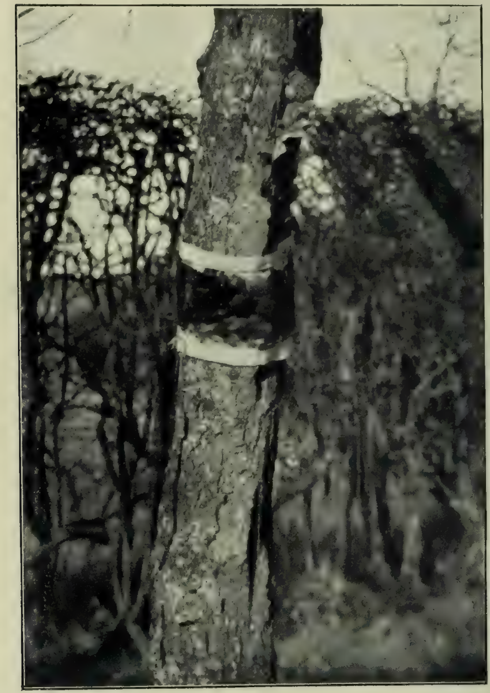
PLATE XXI.



(*F. Edenden.*)

Female March Moths. The lower one laying her egg-band beneath one of the Lackey Moth (× 4).

PLATE XXII.



A grease banded fruit tree, showing how useless paper bands may be on old trees. A *pure* grease will not harm old trees if put on direct.

The most interesting and important are the Leaf Weevils, which seem to be caught in large numbers. Some hundreds of the Green Leaf Weevil were caught in one band. They evidently crawl up the trunk of the trees on hatching from the ground.

Secondly, we may note the fact of the large numbers of Winter Moth larvae that are caught in May and early June. As many as twenty were counted on one band, and there were traces of other dead skins. These were evidently those larvae knocked off during heavy rains. This matter is important to note because it was found that heavy jarring shook the canker worms off the trees, and that they regain the foliage by crawling back up the stems. Thus, if we can get a lasting grease it is well to let the bands remain on until the end of June.

As Winter Moth *may* appear as early as the first week in October, it is well the bands should be in working order by then.

From October on until the end of April the wingless females of Winter, Early, Mottled Umber, Pale Brindled Beauty and others, keep appearing, and then later the Leaf Weevils and Winter Moth larvae are caught up to the middle of June. We must also remember that Winter Moth will lay their eggs below the bands, and as these hatch out in March the larvae, if the bands are dry, can ascend the trees.

It has been several times asked during the past year if the eggs from the burst bodies of the caught females will hatch. None kept have done so when the females have been caught in a moist grease. But in one case where a female was caught by the legs at the edge of a band, the escaping ova developed normally.

Observations were not kept after June 5th until September. The same clear, shiny grease bands (*c*) were still sticky, and amongst the insects caught in large numbers in September and October were Leaf Hoppers (*Chloritæ*), Storm Flies (*Stomoxys*), numerous Apple Suckers, some Carabid Beetles (*Harpalus ruficornis*), and many Frog Hoppers (*Aphrophora alni* and *Philaenus spumarius*).

Other insects noticed between June and September were Click Beetles (*Elateridae*), Harvestmen (*Phalangidae*), and countless *Muscidae*.

## Experiments with Nicotine Wash.

Nicotine wash has been tried during the past and present years on a number of insects at different stages of growth.

The proportions of nicotine used have been (*a*) 1$\frac{1}{5}$ oz. of 98 per cent. nicotine ; (*b*) 1 oz. of 98 per cent. nicotine and (*c*) $\frac{1}{2}$ oz. of 98 per cent. nicotine per 10 gallons of water both plain, and a similar series with $\frac{1}{2}$ lb. of soft soap in addition.

The insects upon which this wash has been tested in the open were (1) Winter Moth larvae, (2) Gooseberry Sawfly larvae, (3) Rose Grubs, (4) Ivy Red Spider, (5) Psylla, (6) Apple, Plum and Currant Aphides, (7) Turnip Flea, (8) Mussel Scale, (9) Thrips, (10) Cuckoo Spit. The results obtained are interesting. In all cases the nicotine was greatly enhanced by the addition of soft soap. Nicotine alone was found sufficient to kill certain of the insects. Soft soap alone was also found to kill certain of them. Where soap killed its killing power was greatly enhanced by the addition of nicotine, and where nicotine was fatal to a considerable extent its power was greatly increased by the soap.

(1) *Effect on Winter Moth.*

(α) Apple trees sprayed April 3rd with 1$\frac{1}{5}$ oz. to 10 gallons—no soap. Winter Moth larvae 2-4 mm. long. The majority destroyed—70 per cent.

(β) The same plus soft soap. Practically every larva dead in four days.

(γ) Soft soap alone at rate of 1lb. to 10 gallons. No larvae noticed to be affected.

(δ) Apple tree badly attacked by Winter Moth which were 8 mm. long, sprayed with same as (*a*). About half destroyed.

(ε) Two apple trees and five nut trees sprayed with (*a*) in May 27th. Winter Moth larvae varying from 12 mm. to 25 mm., none destroyed at all.

(ϛ) Neighbouring trees were sprayed in each case with arsenate of lead ; the larvae were killed in all cases.

*Result.*

It thus appears that nicotine at the rate advised by Mr. Spencer Pickering, namely 1$\frac{1}{5}$ oz. to 10 gallons will kill the young Winter Moth larvae up to about 8 mm., but it was most effective when about $\frac{1}{6}$ of an inch long. After that size arsenate of lead seemed necessary.

2. *Effect on Gooseberry Sawfly Larvae.*
   (*a*) Two bushes sprayed with $1\frac{1}{5}$ oz. to 10 gallons, no soap. Larvae nearly mature. All dead but four out of thirty next morning. Sprayed May 19th.
   (*b*) One bush sprayed May 27th with $1\frac{1}{5}$ oz. to 10 gallons plus $\frac{1}{2}$lb. of soft soap. No live larvae found next morning; dead ones found on ground.
   (*c*) One bush sprayed with Voss' Woburn Nicotine Extract on same day as (*b*). Result the same.

   It thus seems that nicotine and soap are particularly fatal to *Nematus ribesii* larvae in all stages.

3. *Rose Grubs* (*Tortrix* spp.).
   (*a*) Six bushes badly attacked by *Tortrix*; sprayed on April 21st with nicotine $1\frac{1}{5}$ oz. to 10 gallons, plus soap. Ten found dead out of fifty previously counted alive.
   (*b*) Two bushes sprayed May 25th. No dead larvae found—twenty alive.

4. *Ivy Red Spider* (*Bryobia pretiosa*).

   The whole two sides of a house covered with ivy upon which swarms of Red Spider occurred was thoroughly sprayed with Voss' Nicotine wash on April 2nd. The mites were crawling on the leaves in great numbers. The two following days were fine. Scarcely any mites had been killed, although hundreds of thousands were covered with the wash.

   The same treatment was repeated on the 10th of April and the 7th of May with similar results.

   The effect of nicotine seems to be very slight on the *Bryobia*, and cannot be recommended at all for this purpose.

5. *Effect on Psylla mali.*
   (*a*) Two apple trees which had a few Psylla remaining from last year were sprayed with Voss' Extract as soon as the trusses commenced to expand, before the blossom burst. In every case where Psylla had been marked, examination showed that they had been destroyed, the wash penetrating deep into the trusses.

(*b*) Pure nicotine as before at the rate of 1⅕ oz. to 10 gallons of water plus ½lb. of soft soap was sprayed over a third tree when in blossom. The blossom was unharmed and numbers of dead Psylla were found ; all those marked were dead on the third day after.

(*c*) A fourth tree with a few Psylla on (only twelve were marked) was sprayed with 1 oz. of nicotine to the same quantity of water, and all were found dead next day.

It was evident that nicotine has the power of penetrating not only into the trusses, but also through the collection of waxy threads and oil globules the suckers secrete.

6. *On Apple, Plum and Currant Aphides.*

Voss' Woburn Nicotine Wash was used only for these. It was found to act no more satisfactorily on exposed Aphides than quassia and soft soap.

When such aphides had caused leaf curling its effect was much greater on both the Plum Aphis and the Currant Aphides, but not on the *Aphis sorbi* or *Aphis pomi*. In both the latter far more definite results were obtained with paraffin jelly with liver of sulphur as used by Mr. Getting for the Mealy Plum Aphhis.

Nicotine was undoubtedly shown to be more fatal than quassia to certain species, but the amount of soap must be increased from that used for mealy species, and still better was treatment with paraffin jelly plus liver of sulphur.

7. *Turnip Flea and Cabbage Flea.*

(*a*) Two rows of cabbage badly attacked with Cabbage Flea were sprayed with Voss' Woburn Nicotine Wash on May 15th and May 29th. The plants were well soaked and hundreds of beetles hit off the plants.

On the following days they were feeding as abundantly as ever on the cabbages.

(*b*) Pure nicotine as before (*a*) was also used the same day on two more rows with similar results.

(*c*) A mixture of Voss' Wash plus Swift's Arsenate of Lead was used on May 27th on young cabbage. No rain washed this off. Result very poor, almost as many next day and quite as many after.

(*d*) Turnips germinated a week previous were washed with the same as (*a*) and (*c*). Results the same.

*Result.*

It appears nicotine is of no use for Turnip or Cabbage Fly—nor with the addition of arsenate of lead.

8. *On Mussel Scale.*

One tree only sprayed just as the young were hatching in June. The result was the same as when sprayed with quassia and soft soap or paraffin emulsion. All the larvae were destroyed.

9. *On Thrips.*

(*a*) A bad attack of Thrips on roses was treated with Nicotine Wash (Voss') on July 20th. Larval, nymphal and adult Thrips were all destroyed.

(*b*) At the same time two bushes were sprayed with ½ oz. nicotine to 10 gallons of water, and they were all killed.

(*c*) Two rows of peas were sprayed on June 20th, Thrips being very plentiful on the pods. The attack was quite cleared. Voss' Extract was used on one row and home-made wash on the other at ½ oz. to 10 gallons. The results were the same in both.

(*d*) An earlier spraying when in bloom was neglected, and no notes made.

*The result* of nicotine on Thrips seems to be as marked as it is on Psylla, but a smaller quantity seems to be successful, the killing power of ½ oz. being as great as that of 1⅓ oz. to the 10 gallons.

10. *On Cuckoo Spit.*

(*a*) Roses (Crimson Rambler) were sprayed with Voss' Wash and Campbell Nico Soap on June 2nd. A heavy spray was sent out with much pressure.

The roses were examined on the 4th and the larval insects were practically all destroyed: two hundred counted dead, twenty-four alive.

(*b*) Campanulas were sprayed on the same day with the same result.

(*c*) A large "Rambler" was sprayed with paraffin emulsion on the same day. Three days after a count was made, and only seventy dead ones were found and 200 alive.

The effect of nicotine on these insects seems to be much greater than that of paraffin emulsion. One bush was sprayed with a fine mist of nicotine and the result was very poor compared with the others. The nicotine wash is the only one I have found of any good for this insect.

11. *On Celery Fly.*

(*a*) Six rows of celery badly attacked on the College Farm were well soaked with nicotine wash. Examination of the larvae on three consecutive days after showed the result to be nil. A further examination showed that they matured.

(*b*) Three rows in my own garden were sprayed the same day with nicotine wash.

(*c*) Two rows with paraffin emulsion at the same time.

Both these were badly attacked. No dead larvae were found.

The effect of spraying with either (*b*) or (*c*) may be said to be of no benefit.

The general results of the year's experiments show that for certain insects such as Psylla, Thrips, Cuckoo Spit and young caterpillars nicotine is most fatal, also for certain Aphides.

Its effect on mature caterpillars is very doubtful, and on Flea Beetles and Celery Fly it proved quite useless.

# ANIMALS INJURIOUS TO CORN CROPS.

## Tulip Root in Oats and other Eelworm Attacks.

One of the most serious pests in corn during the past year has been the Eelworm attack on Oats. The disease is known popularly as "Tulip Root" or "Segging." It is caused entirely by the species known as *Tylenchus devastatrix* of Kuhn.

Reports of the serious loss caused by it were reported from the following counties :—Devon, Dorset, Somerset, Wiltshire, Hertfordshire, Middlesex, Kent, Surrey, Hampshire, Sussex, Suffolk, Yorkshire and Monmouthshire. In all, sixty separate attacks were reported, in six cases the loss was entire. In others the estimate given was 40 to 60 per cent. of the crop damaged. In some cases the Tulip Root was accompanied by an attack of Frit Fly (*Oscinis frit*).

In all cases it was reported that late sown oats were most damaged, but in two instances this was not entirely so.

The appearance of attacked oats is very marked : the lower parts of the stems swell up above ground and assume a bulb-like appearance. The whole plant is stunted, the leaves assume an unhealthy appearance and the edges of some of the blades frequently become crinkled and wavy. Later the plants turn brown and die right away.

One frequently finds, and it was pointed out on several occasions by correspondents, that the disease starts in round patches and spreads outwards from them. At other times, the whole field is attacked.

Besides attacking oats, this eelworm also feeds in wheat, in rye, in onions, potatoes, clover, buckwheat, hyacinths and other bulbs, and in many wild plants such as Grasses, Teazle and Polygonum.

It also occurs in hop roots and in many pot plants; also in the stems of wallflowers.

Normally, the *Tylenchus devastatrix* lives as in oats in the stem and leaves, but it may even live in branches. Ritsema Bos says "Never in roots," but those found in hop and other roots are undoubtedly this species.

It appears that when the eelworm has lived for many generations for some time on one food plant, it does not readily take to another, but small numbers pass and then become accustomed to the new host plant in time.

For instance, the eelworm from tulip-rooted oats will not readily take to onions at first. But if a second crop of onions is grown on the same land then the damage becomes noticeable. This eelworm also lives freely in soil and in manure. It is frequently spread by means of the latter. It is frequently noticed that eelworm attack starts in isolated round patches, and it is on these patches that the manure was heaped.

As soon as the *Tylenchus* enter the young oat plants they appear to become swollen and the upward growth is checked or entirely stopped. The lower swollen parts of the plants also become etiolated.

The worms may be found in between the stunted leaves, and also in the leaf tissue near the ground, but I have never found them as high up as the ears in the oats. The worms cannot be seen by the naked eye. They vary in size from one-fortieth to one-twentieth of an inch. In colour they are white or translucent white and under the microscope are seen to be active, the movements being serpentine. Under the $\frac{1}{6}$th power a distinct mouth spine is seen, a sure sign that the worm is a plant parasite.

The female lays a few comparatively large eggs in the plants, and the young eelworms grow very rapidly in the plant tissue. The young resemble the parent, but are blunter at each end. When the young plant dies many of the worms enter the soil as the tissue decays, and may pass on to the next plant at once. If there is no plant to feed on near by, they can remain in the soil for two or three years if it is dried at periods, but if always moist the mature worms succumb in a few months.

Whilst in the soil eggs are also laid, but the larvae seem to me to differ from those in the plant tissue, and resemble a *Rhabditis* stage. In this stage they certainly can remain without plant food for some years.

Very often if weather, etc., is favourable, the plant grows away from the attack and a crop is produced. When it is harvested many of the eelworms remain in the straw, and in this way they get into manure and so are distributed back to the land.

I feel quite sure this *Rhabditis* form is only one stageof *Tylenchus devastatrix*. It is probable that many of the free living soil *Angululidae* are merely stages of other species. Plants appear only to be infected with this eelworm in the spring. I have failed to find any trace in oats before then. In the spring traces may be found as soon as the plant has germinated. No less than twenty were counted in one oat seedling only two inches high. Whether they normally reproduce in the soil is not known, but I fancy they do so in small numbers.

The same species was sent me from two localities in Surrey and one from Nottinghamshire attacking wheat. The effects in wheat are quite different. There is no "segging," no tulip root appearance. The young wheat plants were stunted, showed thickened leaves with wavy edges, and later were reported to be dying down. Some of the small wheat plants sent teemed with this *Tylenchus* in the stunted stem and lower leaves. In one case the land had been previously cropped with beans. Beans and peas are frequently attacked by this species.

The effect in beans and peas is quite different. The lower part of the stalks turn black and decay, and the whole crop is soon destroyed. Many cases of this have been sent me in recent years.

The effect of this eelworm in clover is not understood. Clover sickness is undoubtedly due to several causes. *Tylenchus devastatrix* frequently occurs in millions in clover sick land, and the attacked plants show similar symptoms to those in oats, namely, swollen lower portions. Moreover, I have produced in pot experiments with sterilised soil all the symptoms of clover sickness when the soil has been mixed with the eelworms derived from tulip root oats.

## Eelworms in Potatoes.

Specimens of potatoes were received from a locality near London and another from Kent, which were decaying in large numbers in the ground.

On cutting into the tubers many were found to be hollowed out inside, others showed rotten areas at and near the surface. In all such diseased places the *Tylenchus devastatrix* was found in enormous numbers. There is no doubt they were the cause of the disease. The scrapings of those infested tubers I put in part of one row of potatoes planted in my garden, and here some twenty tubers when dug were found to be similarly infested. Two *pot trials*, however, showed no result. There is no doubt, however, that the eelworm from the specimens sent had attacked the plants in the open, for it was only this patch of twenty hills that showed their presence.

Ritsema Bos refers to this eelworm attacking potatoes and says, "On the surface of the tubers there are discoloured rotten patches, not passing deep into the tissue ; . . . these patches contain the eelworms." A similar affection of potatoes is well-known in South Africa, Tasmania, New Zealand, and elsewhere, but the effect of the *Tylenchus* is more to produce scabby patches on the tubers.

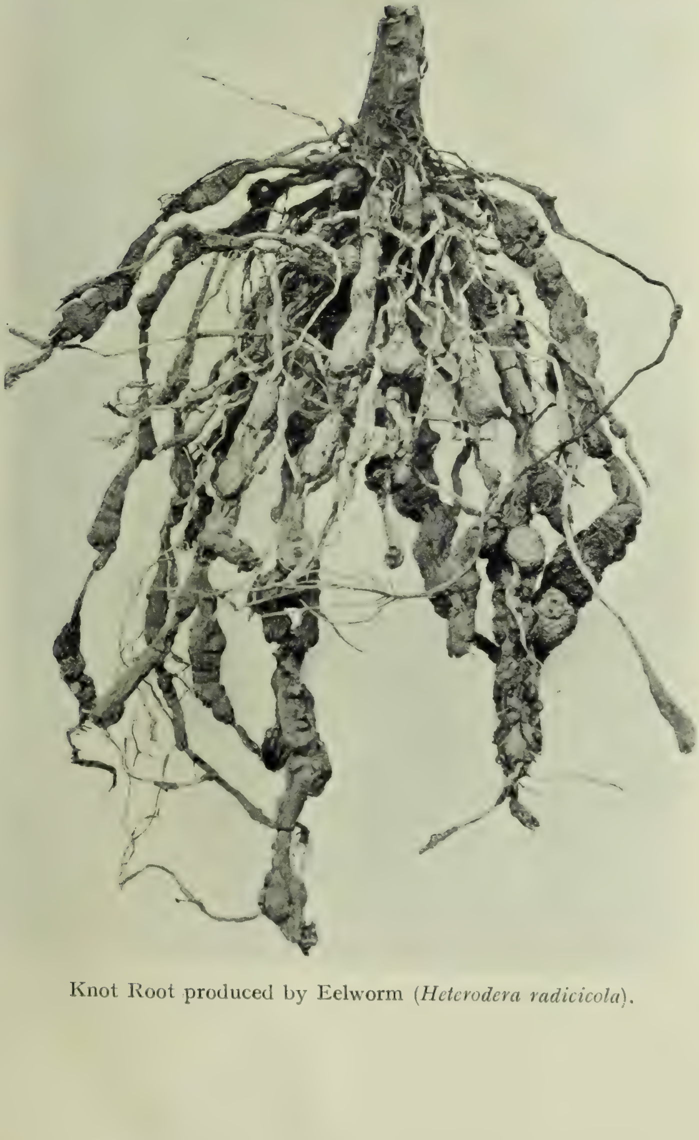
## Wheat attacked by *Heterodera.*

Two more cases have been examined of attack of *Heterodera schachtii* in Wheat. Their presence was at once seen without any microscopic examination, the lemon-shaped females (*vide* Eelworm in Hops) showing up as pearly white specks on the rootlets. One case was sent from Kent, the other was where I had sown some wheat in soil mixed with hop fibres attacked by this pest.

The presence of *Heterodera* in wheat and oats is well-known on the Continent, but was not recorded in Britain before the case reported by Mr. Brown from near Doncaster. (*Vide* my last Report, p. 150).

Wheat plants so attacked show no very marked symptoms, any more than they do when attacked by *Tylenchus devastatrix.* Careful examination, however, soon shows that the roots are dead

PLATE XXIII.



Knot Root produced by Eelworm (*Heterodera radicicola*).

below where the white specks are seen, just as one sees in the hop fibres.

The *Heterodera schachtii* of Schmidt is the cause of "Beet sickness" on the Continent, and the cause of Nettle Head in Hops. Shipley, in the second volume of the "Cambridge Natural History," p. 156, says of this species, "In England especially on the roots of tomatoes and cucumbers." I have been unable to find any other record of this eelworm on such plants, which seem to be exclusively attacked by *Heterodera radicicola*, causing the Knot-root disease so well-known to growers, and a few *Tylenchus devastatrix*.

The life-history of this *Heterodera* has been previously given in these reports.

An interesting point in *Heterodera* was brought to light in 1894 by Vuellemin and Legrain, who showed that these worms, so harmful in ordinary soils, are actually beneficial in dry, desert districts. The genus is common in the Sahara. It causes the rootlets of many plants to swell out, and these act as reservoirs for water.

### *Treatment and Prevention of Eelworm Attack.*

One thing the past two seasons have shown that may be of some value, namely, that autumn sown corn has not been badly attacked by *Tylenchus devastatrix*, whereas spring sown corn has. In districts, therefore, where this pest is rife, it is well to bear this in mind and have all autumn sown corn when it can possibly be done.

After an attack the land should be deeply ploughed; we know for certain that if the eelworms in the soil are buried to a depth of eighteen inches that they are got rid of. The reason is that there they have plenty of moisture and no food: the result is they die. Whereas if near the surface they become dried, and in a dessicated state they may remain alive any amount of time. In fact, certain species in a dried and dessicated condition, such as we get in the Ear Cockles caused by *Tylenchus scandens* in wheat are said to retain vitality for as much as twenty-seven years.

The difficulty of cleaning *Tylenchus* from the soil is not so great in winter as may be imagined. I have found Vaporite clean the soil of this pest if thoroughly applied, but it wants mixing with three times its bulk of fine soil or sand, so as to get a more even distribution. In the case of *Heterodera*, on the other hand, it had very little effect.

In spite of the possibility of clearing soil in this way, one has always to remember that the eelworm is undoubtedly brought to the land in manure. Samples of manure sent me by a nurseryman at Folkestone were found to be full of this species, and the manure was well rotten and short. How this danger is to be avoided it is difficult to suggest, but possibly growers can see a way to lessen this evil.

There is not the least doubt that a deficiency of lime in the soil is beneficial to all *Auguillulidae*. A good dressing of lime will frequently make eelworm infested land comparatively free, and it is advisable to heavily lime land after an attack.

Autumn sowing, liming of land, and top dressing of sulphate of potash are the main things likely to lessen eelworm in corn.

As certain plants do not seem to be attacked, rotation might so be modified to check the pest also. Barley, carrots and mangolds are not attacked by the *Tylenchus*, nor are the two former, it appears, by the *Heterodera*. I have never been able to find eelworm myself in cabbage plants. Clover, peas, beans are badly attacked by *Tylenchus*, and so should be avoided. Rape, sugar beet and beet root are attacked by the *Heterodera*.

Potatoes, although attacked by *Tylenchus devastatrix*, do not seem to become infested if put on land where other crops of plants affected by eelworm have been.

## Other Eelworm Attacks.

Some other very interesting eelworm attacks have been reported and will come in next year's Report, including their presence in large numbers in pear leaves, which were dying, sent me by Mr. Emptage, and found in my own garden. The presence of Eelworm in fern leaves is referred to in this Report (p. 169) and in Begonia tubers.

## The Frit Fly (*Oscinis frit* Linn.).

The Frit Fly has been very bad during the past year. Specimens of attack were received from Yorkshire, Surrey, Kent, Hampshire, Worcestershire, Devon and Herts.

# ANIMALS INJURIOUS TO GRASS LAND.

## **The Heather Beetle** (*Lochmaea suturalis* Thoms).

Heather is now and again badly eaten and damaged by the Heather Beetle (*Lochmaea suturalis* Thoms). This visitation was reported from Caldy by Mr. A. A. Worsley, who wrote on October 5th as follows :—" About the beginning of last August I wrote to you concerning caterpillars infesting heather at Caldy. Now I find there are great numbers of beetles similar to the ones enclosed. Is it likely that these are the imagines of the caterpillars. I found that many were trapped in a hole I had dug about fifteen inches deep with perpendicular sides. The soil being sandy they always fell back after climbing up a short distance."

Caldy is a small village in the South-west corner of the Wirral Peninsular, overlooking the estuary of the Dee. The heather on Thurstaston Hill, half-a-mile away from Caldy, was also attacked. The heather at Caldy was entirely spoilt; it was exceptional to see any flowers.

The bell heather, which flowers earlier, was not attacked at all. This must seriously have affected the honey crop in the neighbourhood.

## **Chafer Larvae** (*Melolonthidae*).

Several cases of damage done to grass were reported in 1908-1909, the culprits being the white grubs or chafer larvae of the small or summer chafer (*Rhizotrogus solstitialis*). These grubs were very plentiful in the south of England and did a good deal of harm to many plants.

In North Wales the Garden Chafer (*Phyllopertha horticola*) was complained of owing to its eating the grass in such manner that it turned brown and died.

It has also caused some annoyance on the golf links at Harlech and Towyn. The Garden Chafer is common in Wales, and I have seen pastures quite dead owing to it.

The drastic treatment of gas liming the land seems best in this case, and the grass comes up better than ever next year.

# ANIMALS INJURIOUS TO ROOT CROPS.

## **The Mangold Fly** (*Pegomyia betae* Curtis).

There is frequently some confusion between Celery Fly and Wurtzel Fly, two totally distinct insects.

A farmer at Egham wrote asking for advice as to how to stop Celery Fly from attacking Wurtzels.

Of course, this was merely an attack of true Wurtzel Fly (*Pegomyia betae*).

The following information sent is worth recording :—" I grew three pieces, one of seven acres, another about three, some 200 yards from the first, and an acre-and-a-half more than a mile from either of the first two lots. They came on very well indeed and were singled out, but about the third or fourth week in May the seven acre piece and the one-and-a-half acre piece were attacked most severely by the Celery Fly, and in the course of a week there was scarcely a plant untouched by them, and the greater part were eaten so badly there was not a single leaf left on the plants. The pest followed them up more or less for six weeks, but during the latter part of the time not so badly. Many of the plants were beyond recovery, but the strange part is that the three acre piece suffered very little. Mangold had been grown on the seven acre piece two years before, also in the three acre piece, but on the one-and-a-half acre piece none had been grown for years, and these suffered the worst of all."

It was also recorded as feeding on the Goosefoot (*Chenopodium album*). It is doubtful if the species feeding in Thistles is the same, the larvae sent me this year for Wurtzel larvae in thistles were certainly a distinct species.

The flies first lay their white eggs on the seed leaves of the mangolds and beets, and it is from this brood, which do little harm, that the generations arise which do so much damage. The maggots which tunnel into the seed leaves I find do not live, but those that get into the first young leaves mature. Frequently one may see a quite small leaf eaten right out, and then the maggot will get into another and so on, until mature.

In the Board of Agriculture Leaflet and elsewhere, it is stated that there are two broods of this fly ; during 1908 there were three distinct generations.

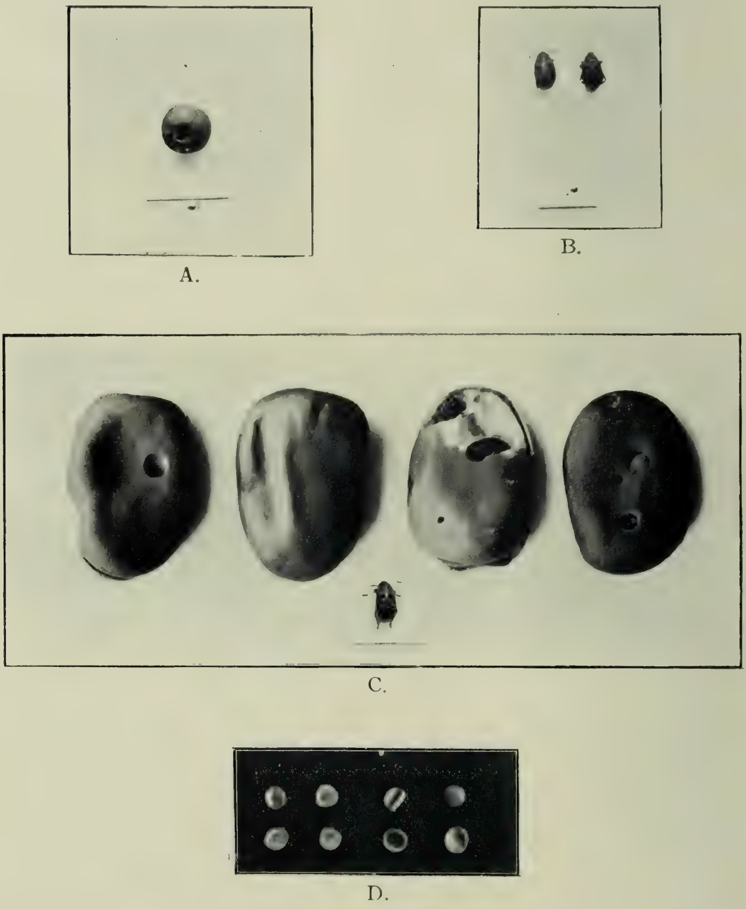
The winter is passed in two ways, namely, as puparia in the soil, or amongst the dead leaf tissue, or as hibernating flies. Several of these flies were kept over last winter, but many of the puparia did not hatch until April and some not until May.

The fly is much like a house fly in general appearance.

So far the only *treatment* likely to do any good is spraying the seedlings as soon as they are showing with paraffin put on as a very fine mist. This seems to keep the first brood of "fly" off, and so prevents the future damage to the crop.

As far as possible all leafage should be destroyed when the roots are lifted after an attack, and the land should be deeply cultivated.

PLATE XXIV.



Bean and Pea Seed Beetles (*Bruchidae*).

A. Pea attacked by *Bruchus pisi*; B. *Bruchus rufimanus*; C. Soya beans attacked by *Bruchus flavimanus*; D. Cuttings left from seeds C.

# ANIMALS INJURIOUS TO PULSE.

## **The Bean Beetles** (*Bruchus rufimanus* and *B. flavimanus*).

The damage done by *Bruchidae* in this country is not often noticed, the reason being that seedsmen of any standing are too careful to send out any infected seed. A case, however was reported in May of last year, Mr. J. Sparrow, of Greenhithe, writing that all his germinating beans obtained from a seedsman were ruined by this pest. The specimens sent showed the damage to be due to the Bean Seed Beetle (*Bruchus rufimanus*). An allied species (*Bruchus pisi*) was also present.

Attacked seeds are easily told (*vide* Pl. 24) by the round depression in the skin, or by the presence of a round hole if the beetle has escaped. On cutting a bean open in the former case a cavity is found in the endospermal part, in which lies a white, slightly curved grub, the larva of the *Bruchus*. Sometimes in broad bean seed as many as four may be found. In peas which are usually attacked by *B. pisi* only one occurs.

There are very many species of the *Bruchidae* found in the world attacking pulse of all kinds. Some have a very wide distribution, having been distributed in infected seed. The European *Bruchus pisi*, for instance, is now common, and very harmful in Canada. It also occurs in Egypt. One species of *Bruchus* does not seem to be confined to any one variety of pulse, and hence, as in Mr. Sparrow's case, the Pea Beetle was found in company with the usual Bean Beetle in Broad Beans.

Although as many as four may now and then be found in one bean, the germ of the seed is not affected. Attacked seed, if sown will germinate and grow well for a few days, then it flags and dies, or as in the case of those under examination, decay sets in the seed and spreads to the radicle and up the young plant, many of which were quite black beneath the soil.

The danger of this pest is not confined to its damage to the plant coming from infected seed, but its introduction into a locality where it may not be normally present.

The Bean Beetle is about $\frac{1}{8}$th of an inch long, black in colour, with brown pubescence and pale spots; the abdomen projects beyond the elytra, and is covered with grey hairs; the legs are reddish-brown. The general shape is characteristic, the head being bent downwards under the body.

The Pea Beetle is easily told from the former by the grey apex of the abdomen having two prominent black spots on it.

The Bean Beetle appears in spring, and may be found on gorse blossom as early as March. Others may be found in the seed up to May. Those in the sown seed emerge from the soil, and with any others that may be in the neighbourhood on gorse lay their eggs on the young seed vessel in the bean or pea blossom, or on the young pod after the blossom has fallen, and the young maggots penetrate into the young beans or peas, and there live in tunnels which they form, and change to the pupal stage either when the seed is ripening or after it is harvested.

The maggot is creamy white and footless.

Soya Beans, which are largely imported from Spain, are often badly attacked by *Bruchus affinis* Fröl, the *Bruchus flavimanus* Bohem. This is not an indigenous insect, and is rare in this country, being recorded only from Bearsted, Barking, Sydenham, Stretford near Manchester, and the Solway district of Scotland. It can be told from *pisi* and *rufimanus* by the projecting lateral teeth on the thorax. It lives quite well in this county, and its introduction should be guarded against.

### *Treatment of Seed.*

It is most important to avoid using any seed that shows the least sign of infection. If any trace of *Bruchus* beetle's working is seen, the seed should be returned to the seedsman.

But if such seed *must* be used, then it should be fumigated to ensure the destruction of the insects within.

The best plan is to fumigate it with bisulphide of carbon. The seed should be placed in a closed bin or receptacle, quite air-tight, and the bisulphide of carbon placed in a saucer on the top of the seed. If the mass of seed is very deep, some bisulphide may hurriedly be poured on a piece of rag and pushed into the mass of seed. The amount to use is ¼lb. of carbon bisulphide to 250 cubic feet of space. The seed is best left in the fumes for forty-eight hours.

Care must be taken in using it, as the substance is highly inflammable. No light of any kind, even a cigarette, must be held near it.

# ANIMALS INJURIOUS TO HOPS.

## **Fever Flies** (*Bibionidae*) **damaging Hops.**

Several cases of the harm caused by *Bibio* larvae to hops have been reported during the past year.

On the 20th of May Mr. W. Arnold, of East Peckham, wrote that " a considerable area of hops failed owing to the attack of the enclosed grubs." There were a few wireworms in the samples sent, and hundreds of *Bibio* larvae and pupae. The latter hatched out on the 21st to 29th of May into *Bibio hortulanus*.

On the 22nd of the same month Mr. Arnold wrote, stating that his apple trees were infested with large black flies: these proved to be *Bibio marci*.

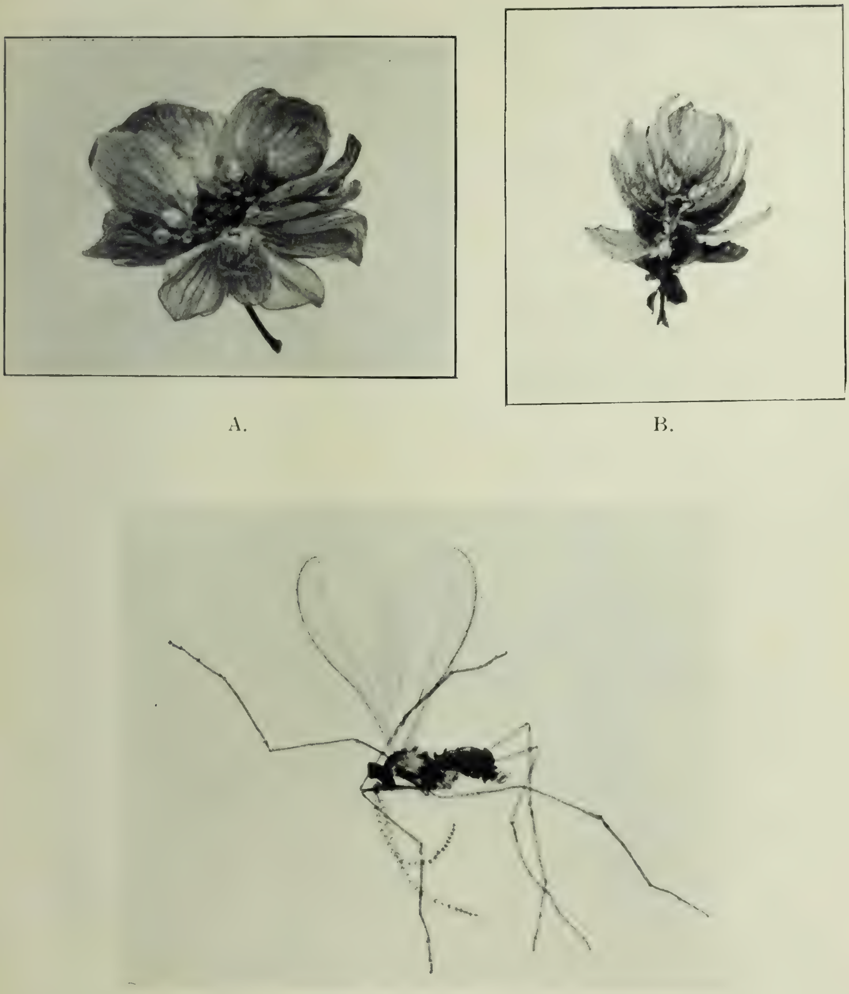
A similar report was sent by Mr. E. Byron Kelsey, of Wickham Court, Dover, who stated as follows :—" I find a large percentage of the hills die off in spring in this garden. Something seems to eat right through the crown of the hills. I find a few wireworms in these hills, but also a lot of a small maggot-like grub. In the tin are several of these maggots."

They also proved to be *Bibionidae* but died unfortunately before hatching out. In a further communication on the 29th of May, Mr. Kelsey said that one of his men had used on another farm a mixture of saltpetre and salt when digging in winter, with good results.

## **The Strig Maggot** (*Diplosis humuli*).

" Strig Maggot " is the popular name given the larva of one of the Gall Midges or *Cecidomyidae*. The adult fly has not as yet been bred out and described. As a considerable amount of material has been received during the past year and more still during the present, it is hoped the adults will be described shortly.

PLATE XXV.



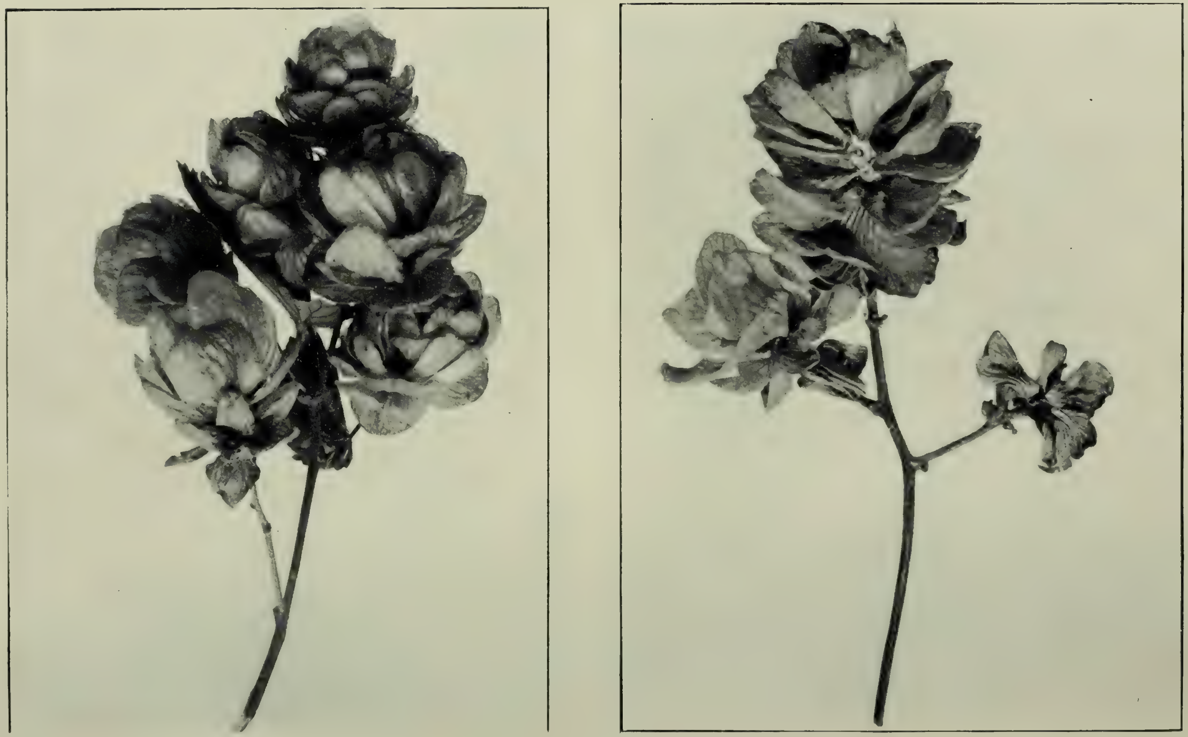
A.

B.

C.

A. and B. Hop Cones damaged by the Strig Maggot (*Diplosis humuli*); C. One of the *Cecidomyidae*.

PLATE XXVI.



A.

B.

Normal Cones A and B Cones attacked by Strig Maggot.

The small white larvae show from their structure and habits that they belong to the genus *Diplosis*, or to one closely allied.

It takes its name "strig maggot" from the fact that we find the white creature tunnelling into the strig or central stalk of the hop cones. The result is the cones are small and deformed, and in most cases the bracts fall or turn brown. In this way considerable harm may be done. It is possible other larvae occur in the strigs as has been suggested by Sir Charles Whitehead, but personally *Diplosis* only have been observed, and there is no doubt that the Cecid is the main cause of damage, and is the common "Strig Maggot."

The attack usually occurs in patches in gardens, but if left it gradually spreads over the whole garden and causes very serious loss.

It has been recorded from near Canterbury, Maidstone, Gravesend, Sevenoaks, and many places in the Weald, Selling in Kent, at Alton in Hampshire, Farnham in Surrey, and Tenbury in Worcestershire. On opening a damaged cone, one may find as many as fifty of the white maggots inside, some crowded in the blackened central strig,others tunnelling into the base of the bracts, and some even freely exposed.

The life-history is not known. The maggots of all stages have been found on August 31st, but by the end of September they have all matured, many by the first week and most by the middle of the month. Those watched sprang from the cones into the air and fell to the ground, where for some time they skipped about like cheese mites.

They soon, however, enter the soil and there they change into the puparium stage. Those under observation did not do so for some weeks after leaving the hops.

A figure of a Cecid found feeding in its larval stage on hop mould is given here to show the general appearance of the adult of the Strig Maggot.

It probably appears about the time the hops come into burr.

It is advisable to pick attacked hops as soon as possible, and have them dried so as to destroy the maggots. Where the attack is general the only plan so far found of any use to check the pest has been heavily folding sheep in the gardens. Vaporite has been found to kill Pear Midge larvae, so that we may safely assume it will these in the open, as I found it do in pot experiments. If it is used it must be spread on the soil soon after the larvae have fallen, as I find it has little or no effect on puparia or pupae.

## A Beetle (*Ptinus fur*) attacking Hops.

These beetles were found in numbers in some hop samples. The sender stated that it was thought they came in the paper, and were not in the hops themselves.

This beetle is a household beetle, and has very varied habits. Numbers were once found in some silver prize cups at the S.E. Agricultural College in 1901, and were said to be always coming back into them. One never knows where this beetle may not be found. It is a great enemy to Natural History collections, both animal and vegetable, and the same may be said of artificial animal and vegetable substances.

The male and female beetles are very different in appearance: the male is of an elongated oval form, whilst the female is inflated.

In colour they are reddish-brown with two narrow, more or less indistinct bands of white pubescence on the elytra in the female, one in the male. The head is bent under the thorax in both sexes. The slender legs are very noticeable, but these beetles move but slowly. They deposit their eggs amongst the dried animal and vegetable substances, and the larvae also feed upon them.

The specimens received with the hops may have come via the paper, but that they were feeding on the dried hops there was no doubt whatever. The hops were eaten out in holes, and in a few days the bottlefull was soon reduced to dust. Eggs were laid in the hops, and the larvae fed on them for six days and then, evidently through lack of moisture, died off.

Nothing but further drying or sulphuring the hops would kill the beetles, and their larvae, and then it is doubtful if the latter would kill the eggs. A temperature of 125° F., however, was found fatal to the eggs as well as to the adults and larvae.

## Eelworm in Hops.

An inquiry *re* Eelworm in hops was received from Mr. J. Adams Partridge, of Woodston House, Tenbury, in February. Others from Mr. Best, at Suckley, from Ticehurst in Sussex, and several from Kent during the past year.

There is no doubt that eelworm is much on the increase this last few years in hops, and in some cases reported and examined they were undoubtedly the cause of the disease.

During the investigations true " nettle head " was found always accompanied by great numbers of the eelworm known as *Heterodera schachtii*. No other organisms occurred that could account for this disease, and we may now safely say that " nettle head " is caused only by the *Heterodera*.

On the other hand several cases put down to eelworm that I examined were not due to this plant parasite, no trace of the readily seen swollen females being found, nor any trace of the marked damage they do to the hops could be detected. The " nettle head " disease occurred to a small extent in the College hops two years ago, and *Heterodera* were found in abundance on the roots, but the plants were all grubbed and the disease has not appeared since.

On examining some hops that were dying on the College farm showing at first stunted growth, the common root eelworm (*Tylenchus devastatrix*) was found in some numbers in three hills, but none in a fourth showing similar unhealthy symptoms. A bad attack of the dying back of hops was investigated at Rainham, the bine sometimes dying back from the top at others from the ground. On these a certain amount of *Tylenchus* was present, but not enough to account for the dying back to such an extent. In both these cases, and in others examined previously, the spores of the fungus, *Fusoma parasitica*, occurred also in numbers in certain parts, but Mr. Salmon did not think that this could have been the cause of the disease entirely.

The presence of these two organisms is interesting, however ; but which was first comer, and whether either had any definite action in causing the dying back is not known.

All that can be suggested at present is to grub any hill at once showing any signs of such diseases and well disinfect the soil with hot lime.

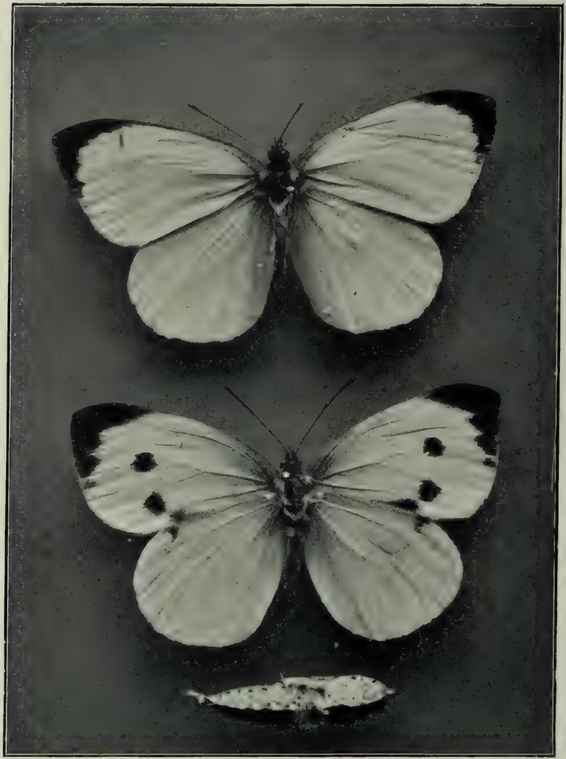
An interesting feature is that if a nettle-headed set is taken up and replanted, the disease as a rule does not recur.

Some pot experiments recently carried out show that Vaporite will destroy free eelworm in the soil, but that it had no effect on their ova.

The same may be said of sulphate of potash, but I am informed in the case of nettle-head this has had no effect in checking the disease, which cannot be explained in view of the fact that in pot experiments it is fatal to them, and a second later dressing a month after the first destroyed those eelworms which had hatched in the meanwhile.

Whilst *Heterodera* are found almost exclusively on the fibrous roots, the *Tylenchus* only seems to occur on the thick roots and work right into the cortical tissue, which decays very rapidly.

This *Heterodera* readily attacks wheat, and this was found to be attacked in six weeks after germination when sown on soil in which nettle-head roots had been incorporated. It is possible that wheat might be used as a trap plant around infected hills, dragged up and then burnt. From what I have seen in pot experiments this is worth trying in the open, as an experiment; the shiny globular females can easily be seen on the wheat roots by means of a lens, and even by the naked eye in a good light.



(*Edenden.*)

The Large Cabbage White Butterfly (*Pieris brassicae*), male and female and chrysalis.

# ANIMALS INJURIOUS TO VEGETABLES.

### **The Large Cabbage White Butterfly** (*Pieris brassicae* Linn.).

During the past year the amount of damage done by the larvae of the Large Cabbage White Butterfly, or *Pieris brassicae* of Linnaeus, has been so great in parts of East Anglia and elsewhere that some reference is made to it. No less than twenty inquiries were received asking how to be rid of the caterpillars. The best account of this common butterfly I know of is given by Curtis in his "Farm Insects," pp. 94-100, and whose excellent figure of it has been copied again and again. Nothing fresh has been written since his time, and there is little fresh to add.

The white butterfly with black markings and yellowish coloration beneath on the second pair of wings, shown in the photograph here, are well-known. The female has two black spots on the upper wings, and so can at once be told from the male.

The size varies very much, the female from two-and-a-half to three inches, the male from two to two-and-a-half inches.

This butterfly appears from April until October. Last year specimens were taken on April 12th, and many as late as October 10th. In certain years they occur in enormous swarms, suddenly. In August of last year on the 7th, thousands occurred in the air near Wye, the cabbage fields and allotments being alive with them for some days. They then disappeared, to be followed shortly after by a violent attack of the caterpillars, cabbage of all kinds being destroyed.

The caterpillars when full grown reach an inch and a half, and are dull pale green above, yellow beneath, with a line of the same colour down the back, edged with black dots ; also a row of large black spots down each side and numerous black specks scattered over the body and fine hairs.

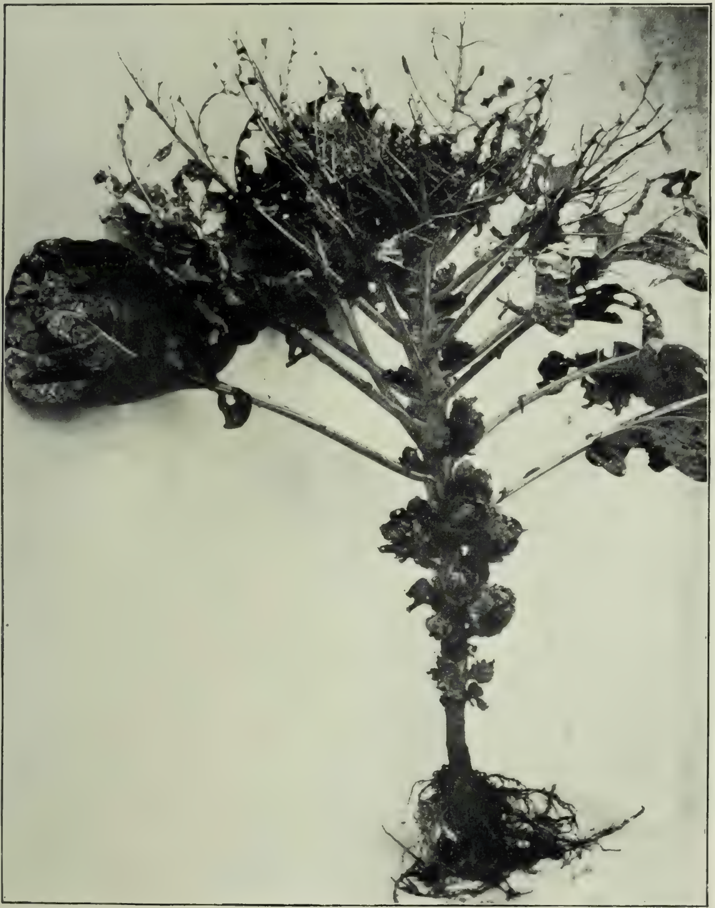
The caterpillars feed on all kinds of cabbage, turnips, swedes, mustard, rape, radish, water-cress, nasturtiums, geraniums, mignonette, etc.

The ova are laid in clusters upon the leaves on end, usually on the lower surface in clusters of twelve up to sixty, rarely up to 100. In confinement they lay them in smaller companies. They are dull lemon yellow, sugar loaf shaped and ridged and reticulate, with fifteen to seventeen longitudinal ribs, about 1 mm. in height. Before hatching the egg varies in colour, the top pale, then black at the shoulder, the lower and greater area yellow. Those under observation hatched in from two to five days, but Butler records that " eggs of September 1st produced the larvae next day," and again " eggs found by me on September 15th produced larvae September 25th and 26th." Again he records, " Eggs laid August 12th, larvae hatched August 18th."

The young larva is nearly 2 mm. long ; it devours its eggshell as a rule ; its colour varies from green to brownish-green with black spots. After the first moult they are 5 mm. long, and the colour yellow-green, the dorsal line yellow, the spots or warts darker and more prominent and the hairs stiff. After the second moult they are about 8 mm. long, yellow, with a green tint in front and head black ; after the third moult they are 12 mm. long, and become more yellow at the sides, the sub-dorsal area greyish-green ; after the fourth moult they reach nearly an inch and the black head has become pale. The full-grown larva is about 42 mm. long and tapers somewhat towards the head, and the back varies from a light bluish-green to grey-green or yellow, the sides dull yellow, the belly dull green and black warts and spots. Legs yellow with black marks. They may complete the changes from egg to pupa in one month, but may take six weeks.

The pupa or chrysalis is fixed to plants, stones, etc., but walls, and fences are the favourite places. The pupa is held by silk at the tail, and by a belt around it above. These pupae remain all through the winter, no cold seems to harm them. The pupa varies in colour from pale greenish-white, the head spike blue and yellow and other yellow marks, the whole with black specks and dots ; others are mottled green and grey and white with very small spots.

PLATE XXVIII.



(F. Edenden.)

Work of the Large Cabbage White Butterfly Caterpillars.

*Parasites.*

These caterpillars are much preyed upon by parasites, the two chief being *Microgaster glomeratus* Linn., which lays numerous eggs in them, and the small white maggots feed inside until the host is nearly full grown, when instead of changing to a pupa the fleshy maggots come through the skin and form oval silken yellow cocoons in great masses, as many as 100 I have seen in one caterpillar. These hatch out next April and May.

Several others are mentioned by Curtis including *Pimpla instigator* Fab., *Pteromatus brassicae* Curtis, *P. partiae* Linn. and *Polynema gracilis* Nees.

*Prevention and Treatment.*

The chrysalids should always be destroyed when we find them in autumn and winter.

Cabbages when attacked may be either sprinkled with finely powdered lime or watered with lime water.

Where cabbage ready to cut are attacked, salt water is best to apply.

One frequently sees pieces of brimstone hung up amongst cabbages to keep the butterflies off. I have been unable to verify if this does any good. One year I found my gardener had swung glass jam-pots on sticks in one cabbage bed, and certainly no butterflies went near in bright weather. The effect was very marked, and is worth trying.

## Bibio larvae attacking Rhubarb.

The following communication was received from Mr. Tanner, of Ayleston Hill, Hereford, in December.

" I grow large quantities of rhubarb for forcing, and as you no doubt know, we plough out the roots at this time of the year to put into the forcing sheds. My trouble is that when the roots are ploughed out, there are large numbers spoilt, apparently by insects of some sort or other. I have just ploughed out nine acres, and although there was a good crop of green rhubarb on this field *this* year, there are considerably more than half of the roots destroyed. I enclose some of the grubs that have done the damage. We found many roots with hundreds of grubs in each root."

These larvae proved to be *Bibionid* larvae of the genus *Bibio*, and the species *B. hortulanus*, an omnivorous feeder. A few suggestions only could be made in such an attack, as no special method of coping with rhubarb pests is known.

### **The Celery Fly** (*Acidia heraclei* Linn.).

This pest was inquired about from Orpington by Mr. J. H. Crickmay, who stated that it caused a good deal of trouble there, from Greenhithe, from Newark, from Monmouth and from Clevedon. The damage done during the past year was considerable and in some districts much celery was ruined by it.

The life-history is well known, and none of the prescribed methods of remedy have been found of the least use personally. The only ways I have been able to keep the celery fly in check are by first protecting the seedlings before planting out. This may be done during the bright part of the day by having the seed beds covered with muslin or canvas, in the same way tobacco seedlings are protected abroad, or by catching the flies in nets by sweeping the rows when the flies are seen about. The latter way I have found completely successful three years running, and in all cases check rows were kept.

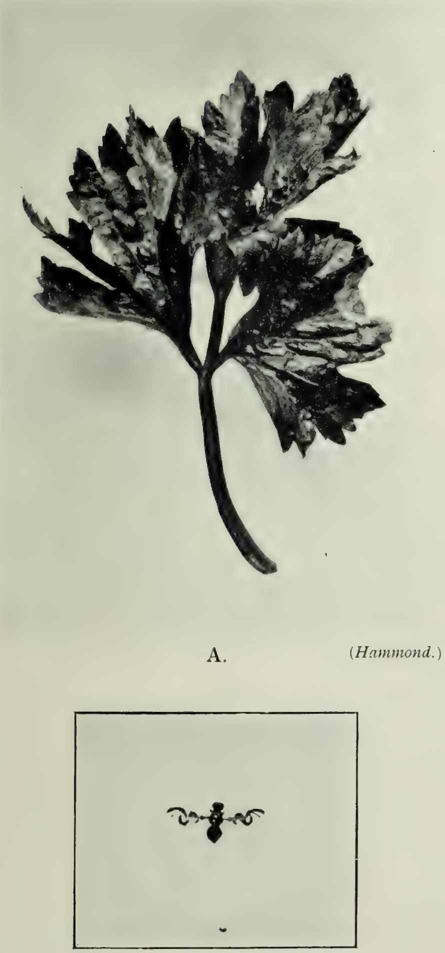
As soon as the marked flies were noticed on bright days, the rows were rapidly swept backwards and forwards twice over with an ordinary butterfly net. The result was that the six rows thus treated were nearly free from blisters. Two check rows all along were stunted and useless.

It is not difficult to detect the flies, owing to their marked appearance shown in the figure, and then boys may be set to work to sweep them off and kill them by crushing. This does far less damage than pinching the leaves, a favourite garden remedy, and great breadths of celery can be much more rapidly gone over.

The treatment of the seedlings is most important, as it is frequently from the few infected seedlings that the later bad attacks arise. No plants should be set out that show the least trace of damaged leaves.

The effect on young plants is very different to that on older plants. The marked blistering is not so distinct in young plants; the attacked young leaves merely turn brown and shrivel. The

PLATE XXIX.



(*Hammond.*)

The Celery Fly (*Acidia heraclei* Linn.).
A. Damaged leaf ; B. adult fly.

puparia or larvae may be within, and for this reason pulled off leaves should be burnt, and so the brood that starts the progeny of the later serious attack are killed and the blight prevented.

### **The Celery Stem Fly** (*Piophila apii* Westwood).

This celery pest, which must not be taken for the Celery Fly (*Acidia heraclei*), was inquired about by Mr. T. Harding, of Westerham. He referred to it as the "Heart" Maggot. This small maggot works into the leaf stalks of the celery, and now and again does much harm. Very little is known of its economy. From the few observations I have made on it, it seems to be worse where celery is paper wrapped before earthing.

Similar complaints were also made from the Isle of Ely, where this stem maggot appears to be harmful.

### **The Cabbage Root Maggot** (*Phorbia brassicae* Bouche).

An inquiry came from Newark in August concerning the damage done to cabbage in that neighbourhood. The correspondent stated that "he was told it had destroyed acres of cabbage" around Newark. The specimens sent showed that the plants were not only badly attacked by the maggots of the Root Fly, but also with Club Root. The combination of these two pests is not at all unusual.

The Cabbage Root Fly was also reported again from Cornwall, near Penzance, and from Suffolk and Kent. This pest has already been fully dealt with in these Reports.

It was also complained of in the Essex flats, where it seems to do harm every year, together with the Club Root.

### **The Asparagus Beetle** (*Crioceris asparagi* Linn.).

The general opinion amongst asparagus growers is this country is that the Asparagus Beetle is not a serious pest, because it only attacks the fronds. The damage done then must be nevertheless of considerable loss to the plant, both in relation to root growth and berry formation.

The chief harm, so often occurring in America, is to the shoots as soon as they are coming above ground. Not only do the beetles gnaw the delicate shoots and spoil them above ground, but they do likewise below ground, and still more in America they lay their eggs on them, and the squashed ova spoil the look of the heads for market.

Investigations and inquiries made some years ago amongst asparagus growers in this country failed to trace any such damage. Since then complaint of loss to the shoots has been made from Hythe, near Southampton, and the writer two years running found similar damage, which had previously been attributed to slugs.

Last season (1908) this beetle was reported from Pluckley as being " very troublesome and very numerous " on the 25th of May, and was stated to be " attacking and eating the young heads both under the soil and after they had come through, in fact quite spoilt the larger number."

The best way to cope with the Asparagus Beetle is first to have the beds constantly hand-picked on bright warm days, and later if any persist, to spray the fronds with arsenate of lead. By this treatment alone I have been able to clear it out entirely.

There is no doubt that the beetles do a good deal of harm by eating the young shoots *below* ground, and so cause deformed and woody shoots, which are unfit for market. We cannot destroy these beetles below the soil, and thus it is most important to kill them when we can on the fronds.

One case has also been reported from near Brighton, of the ova laid by the beetles on the young shoots, and the presence of the repulsive larvae on them. This form of attack, which is so troublesome in America, is not usual here. Heavy dressings of salt, so beneficial to the plant, are also harmful to the larvae.

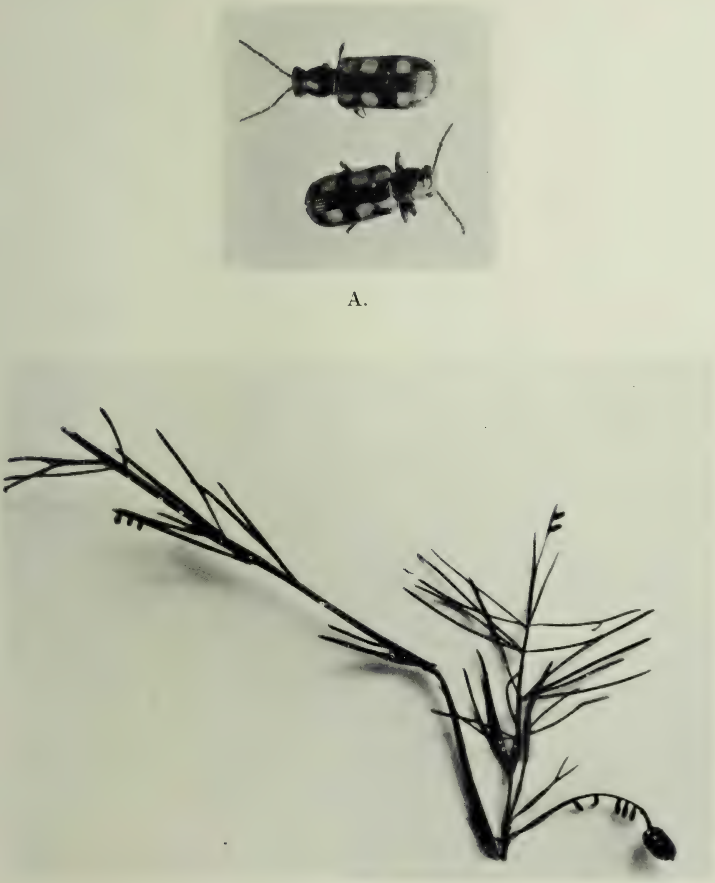
### Carrots attacked by *Aphis carotae.*

Two cases of damage, caused by an Aphis, to carrots were notified in 1908. One by Mr. C. A. Ealand, Director of the County Technical Laboratories, Chelmsford, and another from the neighbourhood of Wye.

The attack was marked by the cracked nature of the taproots, in some the cracks went the whole length of the carrots, in others as small patches.

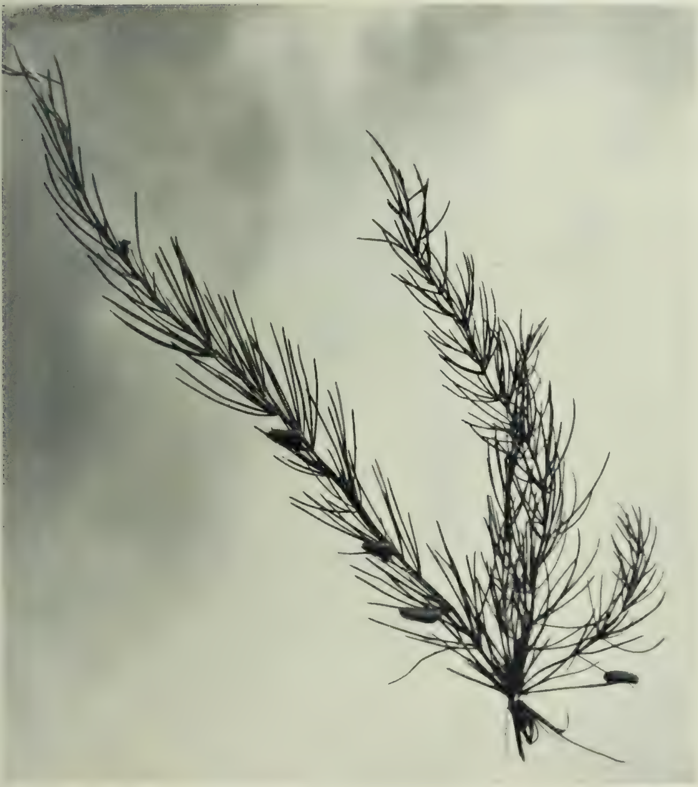
This appearance I am told by various gardeners, is not unusual, and it has been attributed to woodlice and millepedes. Observa-

PLATE XXX.



Adults A of Asparagus Beetle (enlarged) and ova B on fronds × 2.

PLATE XXXI.



(De'Ath.)

Larvae of the Asparagus Beetle at work.

tions made, however, tend to prove that the real cause is the mealy *Aphis carotae*, which is found congregating in the crevices.

This aphis was also found on the leaves, having come from a winged generation appearing from the soil.

In one case investigated, quite half the aphides on the leaves were dead, having been parasitised (in 1906), but last year in the same garden the pest was as bad as ever, and this year it is much the same.

This aphis has been referred to as *Aphis subterraneus* of Walker.

## Mushroom Pests.

Writing in September, the Manager of the Northdowns Mushroom Company stated that " the enclosed beetles burrow into the soil with which the beds are covered, and damage it so that it all falls off just as the mushrooms are showing, and so spoil the beds and damage the crop."

The beetles proved to be *Aphodius fimetarius*, a common dung feeding beetle.

Later on in the month another pest was forwarded from the same source with a note that it was causing a good deal of trouble. This proved to be one of the Aptera—a *Podurid*, which swarmed over the mushrooms and gnawed the skin, and thus completely spoiling them for market as well as causing them to become deformed.

Watering the beds with nicotine before the mushrooms appear seems to be successful.

The Aphodius beetles, the manager tells me, were destroyed by hand picking as soon as they came out.

The French growers use Lysol as a means of keeping down insect enemies in the beds. This has not, as far as I am aware, been used here, but it is well worth trying.

## Sterilisation of Soil.

The increasing prevalence of Eelworms or *Anguillulidae* in soil has necessitated the sterilisation of the soil in many cases to ensure anything like successful glasshouse or pot cultivation.

These worms are now known to attack all manner of plants under glass, strawberries, tomatoes, cucumbers, arum lilies, bulbs, ferns, etc.

The soil becomes impregnated with them, and in it they can live for a considerable period.

It is thus necessary to treat the soil in some way to ensure its freedom from the worms and their eggs. Many substances seem to be effectual in destroying the hatched worms, but these have apparently no effect on the ova.

The treatment in this country so far has been baking the soil, which undoubtedly has the desired effect, but on a large scale this is almost impossible to do satisfactorily.

A plan in vogue in Rhodesia of treating soil to sterilise it, before using it as a seedbed for tobacco, might well be adopted here for the soil used under glass.

The process is to spread the soil out a few inches deep, then well water it.

Over the soil are thrown numbers of dry branches (in this country we could use dry fir or pine branches), and these are lighted with shavings, or in any way most suitable to the operator. The result is that the heat generates steam from the moist soil, and this is driven into it, the result being that not only are all insects, worms and their ova destroyed, but also weed seeds.

One fact must still be remembered, namely that the eelworms are also spread in manure, and it might be advisable to treat this in the same way ; or at least mix hot lime with the compost.

# ANIMALS INJURIOUS TO FLOWERS.

## **Weevil larvae damaging** *Echevinas.*

Some specimens of *Echevina* were forwarded in December in which the entire centre of the plants had been eaten out. The specimens were from the Royal gardens at Kew.

The larvae found doing the damage were Weevil larvae of the genus *Otiorhynchus.* They hatched out and proved to be *Otiorhynchus picipes*—the well-known Raspberry pest, frequently referred to in these reports. It seems the list of food plants of this insect grow wider every year, partly from observation, and possibly partly from change of habits.

## **The Rose Leaf-rolling Sawfly** (*Blennocampa pusilla* Klug).

This rose pest was reported from Preston, where it had been doing damage for the last two years. As many as one hundred and forty bushes were attacked in one bed, and the correspondent reported that they had been seriously damaged by these insects.

The sawfly from which these larvae arise appears in May and June.

It is shiny black, the legs with whitish knees, tibiae and tarsi, and with dusky iridescent wings. The length of the body is only one-sixth of an inch.

The female lays her eggs on the leafage. The larvae are green with pale green areas at the segments, and a brown and white shiny head. When full-grown they fall from the leaves and pupate in the soil, usually during August. There seem to be two broods. The eggs laid in May produce a second brood in late June and early July, and it is these which pass to the soil in August. The grubs spin cocoons of silk, covered with soil, and remain in them as larvae until February and March, when they pupate. The very marked rolling of the foliage seen in the photograph makes this attack easily identifiable. Cameron in his work on British *Phytophygous Hymenoptera*, says that this rolling of the leaves is partly due to the incisions made by the females in ovipositing, but it is undoubtedly mainly caused by the immature larvae. The rolling of the leaves varies in form, but it is nearly always lateral, and the rolls cylindrical. The foliage which is attacked loses its vitality, and in many cases falls prematurely.

I have had reports of it also from Stockport and district, various places in Somerset and Kent. Both teas and hybrids have been mentioned as suffering from the attacks of this insect. Wild roses are often to be seen attacked by these larvae, and I have noticed that attack starts where suckers have been allowed to grow more often than in other cases.

This rose pest may easily be introduced into a garden in the earth attached to the roots of briars. Hand-picking is usually all that is necessary, but both arsenate of lead and tobacco wash are fatal to the larvae, if taken in time. Few are killed, however, by spraying when once the leaves are tightly rolled up.

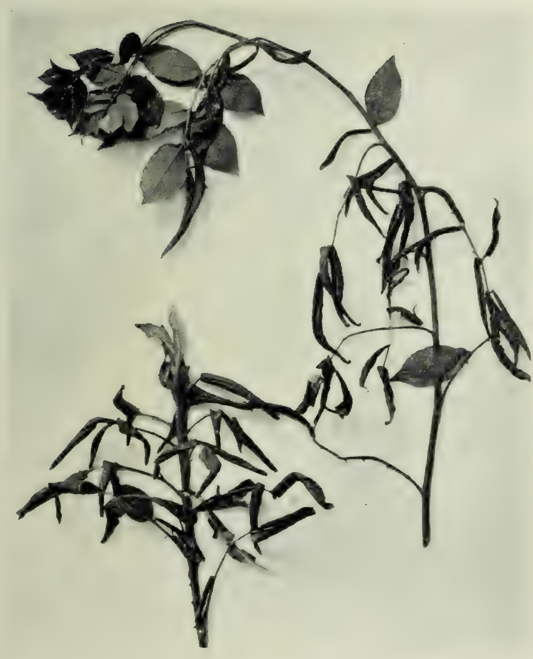
### **The Rose-leaf and Shoot Sawfly** (*Emphytus cinctus* Linnaeus).

An inquiry concerning damage done to a customer's roses came from Messrs. B. R. Cant & Sons in February. The culprit proved to be the Rose Leaf and Shoot Sawfly (*Emphytus cinctus*).

This widely distributed insect was also sent from Worcestershire and Yorkshire. It appears to have done considerable harm also in the London district.

The larvae are dark green above, pale below, and at the sides, and the skin is covered with small white spots ; the head brown, yellow and black, and the legs white with a dark mark over each of them. These larvae eat away the whole substance of the leafage, frequently holding on with their front legs, and the rest of the body at an angle to the leaf ; at other times we find them rolled up in a coil beneath the foliage. They were first found this year in Kent on July 12th, and went on occurring to October. The damage recorded during the past year was not in connection with leaf destruction, but damage to the shoots. When nearly

PLATE XXXII.



The Work of the Leaf-curling Rose Sawfly (*Blennocampa pusilla*) (¼ nat. size).

mature they eat into the shoots and branches and tunnel up them, and in these tunnels they form cells in which they pupate. Those kept under observation in July were seventeen days in the pupal stage only. As far as I can find the winter is passed in the wood, especially where there has been pruning—the last larvae making their way into the pith at the cut end and there they remain all the winter.

Treatment is quite easy, namely spraying to kill the larvae on the foliage. Either hellebore wash or tobacco wash may be used for this purpose. Nicotine I have found just as fatal to these and other rose sawfly caterpillars as for the Currant Sawfly.

## Ants (*Formicidae*).

Ants were particularly abundant in 1908, and the hard winter has not lessened them, for this year they are, if anything, more plentiful. Writing from Orpington, Mr. J. H. Crickmay said they were very plentiful in the ground around there in August, and to such an extent that things would not grow. This has been a general complaint, and no less than three species have been sent in as doing damage.

Amongst the many cases reported of the harm they have done may be quoted the following:—" Nests found near the roots of French Artichokes and the plants killed" ; " The small red ants are killing the borders of Saxifrage" ; " The black ants sent are destroying the tips of young peach trees. There are *no* aphides present" ; " Great patches on the lawn are bared by the ants, which seem to be eating the roots of the grass" ; " The grafts which I enclose have been entirely destroyed by brown ants" ; " The rose buds you will see have been gnawed by some small creature, nothing but ants can be found, and I am sure they do the damage."

Observations have been made during the past year upon these insects, and I am sure they are the cause of a great deal of direct harm as well as indirect harm by tunnelling the soil, covering plants with the debris brought up, etc.

Moreover, I have watched ants carrying aphis from place to place, and in this way an apple tree kept under constant observation was infected with *Aphis pomi*.

Several experiments have been made with various substances to kill ants, and amongst the most successful have been the following :—Injections of disulphide of carbon ; waste acetylene refuse ; boiling water ; and Vaporite.

For dome shaped ant nests, especially in fields, the best results were obtained by injecting one ounce of disulphide of carbon into each hill. This was not found to exterminate them at one application, for in a few weeks the nest was alive again. Three injections made at two weeks' interval, however, destroyed the colonies, and the best results were obtained with four injections of half-ounce to each hill on each occasion.

For non-dome forms, especially where working in loose soil, I got the best results with Vaporite, but here again two applications were necessary.

Acetylene waste was equally successful, but its effects on vegetation were so deadly that it was discarded. Boiling water was successful, but difficult of application.

### The Raspberry Weevil (*Otiorhynchus picipes*) attacking Roses.

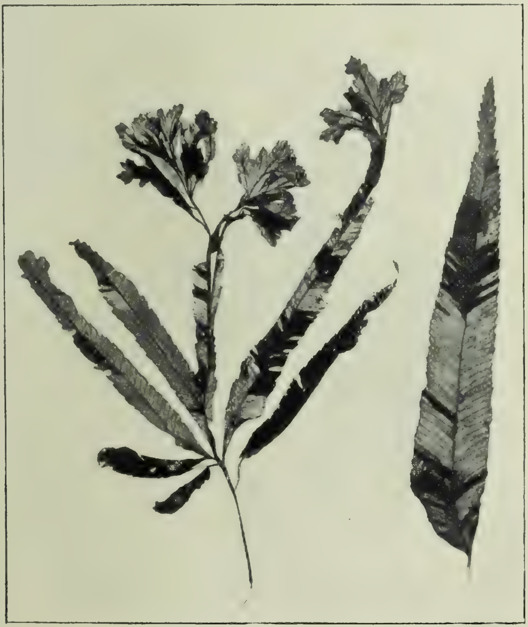
Messrs. Paul & Sons, of Cheshunt, wrote and informed me that this weevil often attacks roses. Several cases were also sent me by the National Rose Society. The weevils attack roses out of doors and under glass. They not only gnaw the buds, but also the rind of the shoots, and in some years seem to do a good deal of harm.

They may be either handpicked or collected by placing pieces of sacking near the bushes where they are found to collect, and so may easily be killed.

### Leaf-Hoppers (*Typhlocyba rosae* Linn.).

Two cases of roses attacked by Leaf-Hoppers were reported, one of which was sent by the National Rose Society. The leaves present a very marked appearance, becoming marbled with pale grey areas, and eventually fall. The cast skins, or exuviæ, of the Leaf-hoppers can always be found beneath these marbled leaves. They lay their ova in the leaves, and the young crawl out and soon commence to feed, later become winged, and may be found skipping and flying from leaf to leaf.

Plate XXXIII.



(*Edenden.*)

Fern leaves damaged by Eelworm.

Spraying with nicotine is the best remedy in the case of rose attack.

## Enchytraeus Worms in Pot Plants.

Numbers of these worms were found in soil from pots sent from Hythe by Mr. C. Duruz, of The Nurseries. In his communication he says, " I have lately been troubled with eelworm. I have to sterilise every bit of potting soil. Since I have sterilised the soil I have found but little of these worms."

They were found to be attacking arums and other pot plants, and destroyed them in numbers.

Here again the mixture of soil with soil fumigants will be found of great service. Sterilisation of the soil is better, however, where it can be carried out.

## Eelworms in Fern Leaves.

In March a curious attack of Eelworm in ferns was sent in by Mr. Emptage. The leaves of *Pteris* go brown in characteristic manner as seen in the photograph reproduced here. On teasing the decayed parts of the leaves in water, considerable numbers of long *Auguillulidae* are at once exposed.

I have not had time to make inquiries on the Continent concerning this disease, but I believe it is known in Holland. A very similar attack on Pear leaves has also been observed, but further details are left until the next annual report.

# ANIMALS INJURIOUS TO FOREST TREES.

## **The Willow Weevil** (*Cryptorhynchus lapathi* Linn.).

The damage done by this weevil is well-known to Osier growers in some parts of England. It is now also well established in America.

Specimens were received from Mr. G. Hooper, in February, from Worcestershire. In his letter he stated " A large basket-maker here who grows a lot of osiers is much troubled by the damage done by the enclosed insects."

Besides osiers and willows it also attacks black and white alders, poplars and birch.

Gillanders says, " It generally attacks alders in preference to the other trees, and prefers young trees from four to six years of age." In most districts in the south-east and west of England it prefers osiers, and is seldom found on other trees. I have met with it doing considerable harm in Huntingdonshire, in Middlesex, Devon, Lincolnshire, Hampshire, Surrey and in Kent. It is very persistent in its attacks on osiers near Wye.

The damage is done by both beetles and the maggots.

The beetles are very marked in form and colour (*vide* Plate IX.C.); in length they vary from 6 to 8.5 mm. The front part of the body is dull black, with tufts of jet black scales on the thorax and elytra ; the ends of the elytra are white usually for about one-third of their length ; in some specimens the white becomes creamy, and in others it seems to be slightly pinkish ; the sides of the thorax are also pale ; the legs are dark except at the base of the femora. I have found the beetles in May, June, July and August.

### *Life-history.*

The beetles eat into the wood and form small chambers, sometimes only just under the rind ; others deep into the wood, where amongst wood chips and a wet substance they lay their eggs. I have never found more than three eggs in any one nidus. The ova are oval and pale creamy white in colour. Those under observation hatched out in twelve days and one lot in twenty days.

The ova are also laid at the base of the buds. The larvae tunnel at first around the stem and in some cases completely girdle it, the result is of course the death of the upper part of the rod or branch. Then the larvae tunnel up and down and form dark tunnels about $\frac{1}{6}$ to $\frac{1}{4}$ of an inch across. In small rods the tunnels may be found in the pith, in larger ones in any part.

The larva is a white footless grub, with a wrinkled skin and brown head.

The external signs are very marked: there are usually signs of frass and wood chips passing out of holes on the osier, swellings and cracks occur on the bark and there is frequent yellow or purple discoloration of the rind.

The pupa is white, and situated near the entrance to the larval tunnel. The pupal stage lasts from ten to fourteen days.

The larvae work most in May and early June. The beetles hibernate in the galleries, in the stubs and amongst moss, and lay their ova first in April and again in July. I have also found larvae during the winter.

Attacked rods soon snap off. The only remedy is pruning out the infested rods when the white larvae are within.

### The Pine Chermes (*Chermes pini* Kalt.).

The presence of this aphis was reported by Mr. R. C. Notcutt on young Scots Fir at Woodbridge, Suffolk, in April. It is especially found on Scots Pine and Austrian pine. The same attack was reported from near Manchester. This aphis shows itself as small, white, fluffy specks on the smaller branches and on the shoots, now and again on the stem. Young stock is mainly attacked, but I have found it on thirty year old Scots in Kent in quantity. When young shoots are attacked, they assume an abnormal bent and twisted form, and frequently die under the attack.

The female may be found in late April, she is dark brown in colour with scanty woolly covering. In late May she commences to lay her eggs. Like other Chermes these are stalked, and form an olive coloured mass over the female's body. In a few days these hatch into little active lice, which wander over the bark and needles, and soon produce white silken filaments. Its complete life-cycle has recently been worked out by Borner* who adopts the name *Pineus pini*.

### **The Felted Beech Coccus** (*Cryptococcus fagi* Barens).

This destructive beech insect was received in November from Oxted, Surrey, with a note that it was appearing on a tree about thirty years old, and which was then quite healthy.

Another correspondent wrote in November saying the beeches in Headley Park, Epsom, were dying from this pest.

It has also recently made its appearance at Gatton Park, where a sharp look-out has been kept for it. Mr. George Hempson sent specimens in January from trees which he said had become covered with the white growth.

I also noticed an incipient attack on the beech trees at Clevedon in Somerset, this September, and one case at Wells in the same county. Owing to its serious nature, it is well if one wishes to save the trees, to spray once or twice in the winter with the caustic soda and paraffin wash.

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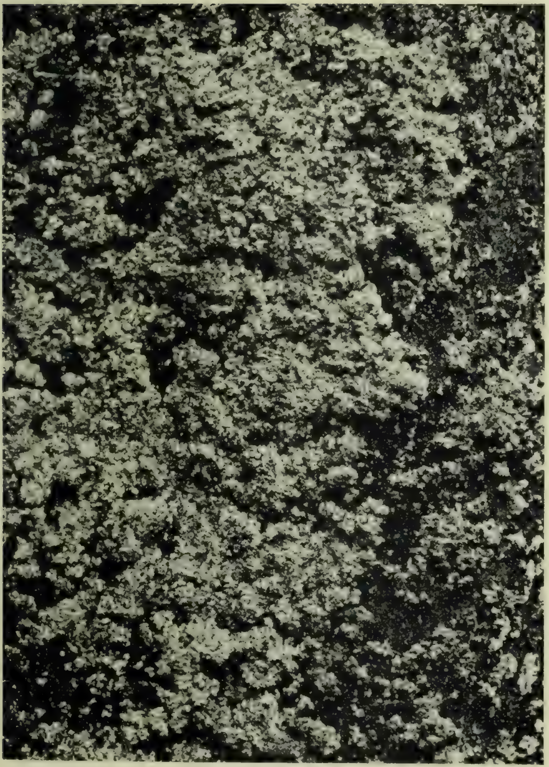
* Eine Monographische Studie uber die Chermiden. Arbeiten a.d. Kaiserlichen Biologischen Austalt für Land-und Forstwirtschaft. VI. Band. 2. Heft. p. 170 (1908).

Plate XXXIV.



The Felted Beech Coccus (*Cryptococcus fagi* Barens).

# ANIMALS INJURIOUS TO MAN'S BUILDINGS, FURNITURE AND STORES.

## Clothes Moths.

The following interesting account of the damage done by *Tineinae* or Clothes Moths was forwarded by Mr. A. B. Neal in February.

" A very large lantern sheet which was being dried to-day has right down the whole of one side a large number of holes, some of them as large as a penny. There were a large number of insect cases fixed to the material, and amongst them were the two enclosed— one appearing to have the caterpillar just emerging, whilst the other seems to be a pupa. Can you give me some information regarding these cases."

These proved to be a species of the well-known Clothes Moths, namely *Tinea pellionella*. The larva is enclosed in a case which it makes out of the various substances upon which it feeds. This case is made of two materials, the inner layer is composed of silk, the outer of fragments of the substance upon which the larva has been feeding, and thus of varied hue. The larva lives and pupates within this case, projecting its head and legs when crawling, and so carrying the case with it. They occur all the year, but breed mostly in summer. The moth is less than half-an-inch in wing expanse ; the front wings are of a shining greyish-yellow, with three darker spots in the middle, whilst the hind wings are greyish. Practically all fabrics, furs and feathers are liable to its attack.

An allied species (*T. bisellliella*) does not form a case when young ; later it forms, however, a kind of tubular tunnel in which it protects itself, this covering is fixed and not moveable like the former. The last named species is the one that so often occurs in furniture, feeding on hair, wool and feathers.

The best way to keep off attacks of these larvae on fabrics, etc., when stored is to keep a liberal supply of napthalene in the cupboards, drawers or boxes, and to give frequent exposure to sun and air.

The only successful way to get them out of furniture is to have the objects treated by heat or saturated in benzine.

A third common species (*T. tapetzella*) is larger, being about three-quarters-of-an-inch in wing expanse, and can at once be told by the forewings being dark on the basal third, the rest of their area creamy white, slightly mottled at the tip. The larvae of this species tunnel into carpets, horse rugs, etc., and line their runs with silk.

# ANIMALS CAUSING ANNOYANCE TO MAN.

## The Mosquito Plague at Woking and Some Notes on the British Mosquitoes.

Complaints were made in the summer and early autumn of the annoyance caused by mosquitoes in the neighbourhood of Woking. It was thought that these swarms originated from the canal, and that they were *Anopheles,* and thus carriers of malaria or ague.

Specimens of the insects were obtained for me by the Urban District Council of Woking, from Sir A. T. Arundel, of Uplands, Maybury Hill.

Large numbers were sent in spirit, and proved to be the common Brown Household Mosquito (*Culex pipiens* Linn.). These were received on October 30th. This common insect breeds in all manner of collections of water, such as rain-water barrels, cisterns, water troughs, small pools, but seldom in ponds, lakes, canals or rivers. It is purely a domestic insect. The mosquitoes occur in houses, outhouses, stables, cellars, etc., and fly mainly at dusk and at night. Although they have a long piercing proboscis, as other mosquitoes have, they do not always suck blood. Now and again this common insect does, however, and causes very nasty swellings on certain people. The females only bite ; no male mosquitoes are known to do so. *Culex pipiens* hibernate in the adult stage ; it occurs in greatest numbers in September and October. In the former month males also occur with the females. The males can be told by their long palpi and feathered antennae, and by their longer narrower body. They fertilise the females and then die, whilst the fertile females hibernate in cellars, outhouses, etc., until May or June, when they deposit their eggs in boat-shaped masses on water. In warm days in winter, however, these mosquitoes come out, but soon hide away again when the cold returns.

The larvae or "wrigglers" feed upon green algae, etc., in the water; they are easily told by their active wriggling movements, and by their constantly coming to the surface film to get air. The air is drawn in through a long tube or respiratory siphon at the tail-end. When doing this the larva hangs with its head downwards. The *Anopheles* which carry malaria, of which three occur in Britain, have no respiratory siphon, and when they come to the surface to breath they lie nearly parallel with the surface film.

The pupal *Culex pipiens* is also active and takes no food. It has two breathing apertures, in the form of two trumpet-shaped bodies on the thorax. These are placed at the surface film when respiring.

I have traced three broods of this common mosquito in Britain. It is by far the commonest of the *Culicidae* in this country, and appears all over Europe, also in North America, North Africa and in India.

It is generally supposed that any mosquitoes that occur in this country are foreign importations. This is quite possible, but so far all the *known* species are indigenous. There are no less than twenty-one British species known, and probably more occur.

I append here a full list of the British *Culicidae*, as that given in Verrall's list of British Diptera* is now out of date.

## LIST OF BRITISH CULICIDAE.

### ANOPHELINAE.

Genus ANOPHELES Meigen.

1. *Anopheles maculipennis* Meigen.
2. *Anopheles bifurcatus* Linnaeus.
3. *Anopheles nigripes* Staeger.

### CULICINAE.

Genus THEOBALDIA Neveu-Lemaire.

4. *Theobaldia annulata* Meigen.

Genus GRABHAMIA Theobald.

5. *Grabhamia dorsalis* Meigen.
6. *Grabhamia pulchripalpis* Rondani.

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* A List of British Diptera, 2nd Ed., pp. 12 and 13, 1907.

Genus TAENIORHYNCHUS Arribalzaga.

7. *Taeniorhynchus richardii* Ficalbi.

Genus CULICADA Felt.

8. *Culicada cantans* Meigen.
9. *Culicada morsitans* Theobald.
10. *Culicada diversa* Theobald.
11. *Culicada nemorosa* Meigen.
12. *Culicada waterhousei* Theobald.
13. *Culicada lateralis* Meigen.
14. *Culicada ornatus* Meigen.
15. *Culicada nigripes* Zetterstedt.
16. *Culicada sylvae* Theobald.
17. *Culicada lutescens* Fabricius.
18. *Culicada terriei* Theobald.

Genus CULEX Linnaeus.

19. *Culex pipiens* Linnaeus.
20. *Culex nigritulus* Zetterstedt.

## AEDINAE.

Genus AEDES Meigen.

21. *Aedes cinereus* Meigen.

The following are Reputed British Species :—

*Culicada bicolor* Meigen.
*Culicada vexans* Meigen.
*Culicada annulipes* Meigen.
*Culex rusticus* Rossi (a doubtful species).

The following are recorded by Verrall in his first list of British Diptera* :—

**Culex ciliaris* Linnaeus=*C. pipiens* L.
**Culex fumipennis* Stephens=*C. cantans* M.

and as reputed species :—

†*Culex calopus* Meigen.
**Culex domesticus* German=*C. pipiens* L.
*Culex punctatus* Meigen.
**Culex stricticus* Meigen=*C. nemorosa* M.
†and *Anopheles pictus* Loew.

Those marked with an asterisk are only synonyms, those with a dagger are extremely unlikely to occur in this country.

The complete **Synonymic List** is as follows :—

Genus ANOPHELES.

*Anopheles maculipennis* Meigen (1818).
*Anopheles bifurcatus* Linnaeus (1758).
*Anopheles nigripes* Staeger (1839).

Genus THEOBALDIA Neveu-Lemaire.

*Theobaldia annulata* Schrank, N. Lemaire (1776).
    *Culex annulatus* Schrank (1776).
    *Culex affinis* Stephens (1825).
    *Culex variegatus* Schrank (1781).

Genus GRABHAMIA Theobald.

*Grabhamia dorsalis* Meigen,—Theobald (1818).
    *Culex dorsalis* Meigen (1818).
*Grabhamia pulchripalpis* Rondani ;—Theobald.
    *Culex pulchripalpis* Rondani (1872).

Genus TAENIORHYNCHUS *Arribalzaga*—Theobald.

*Taeniorhynchus richardii* Ficalbi (1896).
*Culex richardii* Ficalbi.

Genus CULICADA Felt.

*Culicada cantans* Meigen—Felt (1818).
    *Culex cantans* Meigen (1818).
    *Culex maculatus* Meigen (1818) ♂.
    *Culex fumipennis* Stephens (1825).
    *Culex stimulans* Walker (1848).
*Culicada morsitans* Theobald (1902).
    *Culex morsitans* Theobald.
*Culicada diversa* Theobald (1902).
    *Culex diversus* Theobald.
*Culicada nemorosa* Meigen—Felt (1818)
    *Culex nemorosus* Meigen (1818).
    *Culex sylvaticus* Meigen (1818).
    *Culex guttatus* Curtis (1829).
    *Culex provocans* Walker (1848).

  - *Culex salinus* Ficalbi (1896).
  - *Culex stricticus* Meigen (1838).
  - ?*Culex reptans* Meigen (1804).
  - ?*Culex fasciatus* Meigen (1804).
- *Culicada waterhousei* Theobald (1905).
  - *Culex waterhousei* Theobald (1905).
- *Culicada lateralis* Meigen.
  - *Culex lateralis* Meigen (1818).
- *Culicada ornata* Meigen.
  - *Culex ornatus* Meigen (1818).
  - *Culex concinnus* Stephens (1829).
- *Culicada nigripes* Zetterstedt.
  - *Culex nigripes* Zetterstedt (1838).
- *Culicada sylvae* Theobald (1903).
  - *Culex nigripes var sylvae* Theobald (1901).
- *Culicada terriei* Theobald (1903).
  - *Culex terriei* Theobald.
- *Culicada lutescens* Fabricius (1775).
  - *Culex lutescens* Fabricius (1775).
  - *Culex flavescens* Villiers (1789) (non Theobald).
  - *Culex flavescens* Fabricius (1805).
  - *Culex thoracicus* Desvoidy (1827).

### Genus Culex Linnaeus.

- *Culex pipiens* Linnaeus (1758).
  - *Culex vulgaris* Lninaeus (1767).
  - *Culex alpinus* Linnaeus (1767).
  - *Culex ciliaris* Linnaeus (1767).
  - *Culex communis* De Geer (1776).
  - *Culex domesticus* German (1817).
  - *Culex rufus* Meigen (1818).
  - *Culex agilis* Bigot (1889).
  - *Culex phytophygus* Ficalbi (1889).
- *Culex nigeritulus* Zetterstedt (1850).

### Genus Aedes Meigen.

- *Aedes cinereus* Megien (1818).
  - *Aedes rufus* Gimmerthal (1845)

## SYNOPTIC TABLE OF BRITISH CULICIDAE.

A. Palpi long in both sexes—as long as the proboscis.—

ANOPHELINAE.

α Hair-like scales on thorax and abdomen (*Anopheles*).

β Wings spotted.—1 *maculipennis* Meigen.

ββ Wings unspotted.

Brown species.—2 *bifurcatus* Linnæus.

Black and slaty grey species.—3 *nigripes* Zetterstedt.

B. Palpi long in male, short in female.—CULICINAE.

α Wings spotted (*Theobaldia*).

Legs with basal white bands.—4 *annulata* Mg.

αα Wings unspotted.

β Wing scales rather broad and mottled (*Grabhamia*).

Last hind tarsal pure white; hind ungues simple.—5 *pulcripalpis* Rondani.

Last hind tarsal dark; hind ungues uniserrate.—6 *dorsalis* Meigen.

ββ Wing scales long and rather broad and dense, fork cells long.—(*Taeniorhynchus*).

Legs basally pale banded; metatarsi pale banded in middle.—7 *richardii* Ficalbi.

βββ Wing scales not dense; fork cells short.—(*Culicada*).

γ Legs basally pale banded.

Abdomen basally pale banded.

Ungues of ♀ all uniserrate.

δ Thorax golden yellow and golden brown scales, with traces of spots and lines.—8 *cantans* Meigen.

Thorax black with pale golden to creamy scales, unadorned.—9 *waterhousei* Theobald.

γγ Legs unbanded.

δ Yellowish scaled species; Abdomen all yellow; fork cells short, normal.—10 *lutescens* Fabricius.

δδ Not yellow.

ε Abdomen with basal pale bands; ungues all uniserrate.

Thorax golden scaled with two median bare dark lines.—11 *diversa* Theobald.

Thorax dark with golden-brown and golden scales, those at the sides paler and brighter than in the middle, forming more or less two pale narrow lines.—12 *nemorosa* Meigen.

Thorax whitish with two black streaks.—13 *ornatus* Meigen.

Thorax black with ferrugidous scales.—14 *nigripes* Zetterstedt.

Thorax black with ferruginous scales, pale ones at the sides.—15 *sylvae* Theobald.

Like former, but with speckled legs and pale scaled area at base of proboscis.—16 *terriei* Theobald.

εε Abdomen unbanded. Thorax black with bronzy brown scales, and median narrow white and broad lateral white lines.—17 *lateralis* Meigen.

ββββ Wing scales thin. Legs unbanded.

Abdomen distinctly basally pale banded.—18 *pipiens* Linnaeus.

Abdomen indistinctly banded, small fragile, wild species.—19 *nigritulus* Zetterstedt.

C. Palpi short in both sexes (*Aedinae.*)

γ Abodmen unbanded ; legs unbanded.—20 *cinereus* Meigen.

# NOTES ON THE BRITISH SPECIES.

At present little or nothing is known of the habits, life cycle and distribution of the British Mosquitoes. Many are extremely local in distribution as far as we know, and some are almost unique specimens. Four species only may be called common, namely :—*Anopheles maculipennis*, *Anopheles bifurcatus*, *Theobaldia annulata* and *Culex pipiens*.

1. *Anopheles maculipennis* Meigen. This is the only spotted winged *Anopheles* found in Britain. It is a malarial carrier.

Its distribution in Britain is very general, the following being definite records of its capture in counties* :—Yorkshire, Derbyshire (Buxton), Lancashire, Cheshire (Chester), Lincolnshire, Nottinghamshire, Norfolk, Suffolk, Cambridgeshire, Huntingdonshire, Bedfordshire, Hertfordshire, Essex, Kent, Hampshire, Surrey, Middlesex, Oxfordshire, Herefordshire (Ross), Buckinghamshire, Berkshire, Dorsetshire, Somersetshire, Gloucestershire (Cheltenham and near Gloucester), Devonshire, Cornwall (Fowey and Falmouth), Monmouthshire (Chepstow and Newport), Carnarvonshire, Glamorganshire, Merionethshire (Dolgelly), Lanarkshire, Invernessshire, Sutherland, Aberdeenshire, Dublin and Down. The exact localities given here are not mentioned by Dr. Nuttall in his paper.

The breeding places of this *Anopheles* are varied : they may be found as larvae in small ponds and pools, even in small mud hollows formed by beasts in pools, near the sea or high up on moorland tracts, and in roadside pools and ditches, mill pools and in sluggish rivers, or places in larger rivers where the water is held up. Such are the localities recorded, but my personal experience in nine counties is that *Anopheles maculipennis* is a domestic breeder, and is found mainly in water-butts, and artificial collections of water near houses. For instance, at my own home they never occur in a small pond near the house (*A. bifurcatis* does in plenty), but every rain barrel is full of them.

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* For exact localities in each county the reader is referred to Dr. Nuttall's paper "On the Geographical Distribution of Anopheles," Journal of Hygiene. I. pp. 4. 25. 1901.

I noticed this in Great Staughton, Hunts, especially. The rain barrels contained hundreds, but not a trace could be found in the small sluggish river Kim, running close by. Exactly the same occurred at an hotel on the Wye at Symonds Yat, a huge rain-water tank swarmed with them, but there was no trace of this *Anopheles* in the river. The range of breeding ground is thus seen to be very wide, and apparently varies to a vast extent in different localities. Recently recorded from Shrewsbury.

### Annoyance caused by *A. maculipennis.*

There is no doubt that this *Culicine* is a vicious biter at times, but its effects are unnoticeable compared to those of the next species. The " bites " I have seen made by this species in Britain seldom, if ever, raise a weal ; a small red spot may remain with a red suffusion around it, which will spread to the size of a sixpenny piece. This causes but little pruritis. It bites only in the dark as far as my observations go, made during the last fifteen years in the same locality. No ill effects whatever were noticed to follow from the bites of this gnat.

### Habits of *A. maculipennis.*

The adults are found in the open, but are mainly found in houses, outhouses and privies. I have taken females in January, February, March and May, and then again in July, August, September, October, November and December. They are commonest in July, August and September. One thing I have always noticed with this species is that it does not occur in the ground floor rooms, but on the first floor (and perhaps higher). This I have noticed year after year in my own house, and also in other places. Just the reverse is it with *A. bifurcatus* which I have always found on the first floor of houses.

*Anopheles maculipennis* is usually found indoors on the ceilings in typical thorn-like Anopheline attitude. In the thousands I have seen indoors not 2 per cent. have been settled on walls. They seem to like a white resting place also. The noise they make when thirsting for blood is a low vicious sound, but at other times they produce no noise at all. I have only found males in autumn, and then never indoors, but I have frequently taken them in dark outdoor privies in September and October, and a few in November. All the males I have kept in cages died before winter, but the females survived.

I have never been able to actually trace where the females hibernate, as one can easily do with *Culex pipiens*, but in sweeping a box hedge near my house in February I obtained several females, and I am inclined to think they pass the winter in such thick sheltered places out-of-doors.

The larvae I have found in June, July, August and September, the majority in the latter half of July and in August. On several occasions I found numbers of them in rain barrels in September, and these hatched into flies on the 22nd of October in one case and the 27th in the other. (Other records were not kept).

On one occasion last year the larvae were found on September 29th, and did not hatch until October 11th.

2. *Anopheles bifurcatus* Linnaeus. This brown unspotted winged *Anopheles* is also common, but it is of more sylvan habits than the former. It is a vicious biter, and according to my observations it bites mainly at or about sunset. It is mostly annoying in the neighbourhood of woods and spinneys near stagnant water. It settles at once on the face, if possible, or on the hands, never it seems on covered flesh ; makes no noise and produces no pain in puncturing the skin. One was observed settled on a friend's nose for five minutes sucking blood before it was taken off. No scar resulted, no weal or reddening took place, but the insect was gorged with blood, and when examined some days after the red coloration could be seen in the hypopharynx, and remained so the last time I saw the specimen in the British Museum collection.

*A. bifurcatus* occurs indoors, but not in the same way as *A. maculipennis*. In all cases I have found it on the ground floor ; never once above.

This *Anopheles* has been found in the following counties :— Yorkshire, Cheshire, Lincolnshire, Suffolk, Cambridgeshire, Huntingdonshire, Sussex, Kent, (Wye, Canterbury, Tenterden, Rochester, Ashford, Folkestone, Tonbridge), Hampshire, Surrey, Warwickshire, Herefordshire, Dorsetshire, Somersetshire (Bath, Clevedon, Weston, Cheddar), Devonshire (Lynmouth, Okehampton Lydford and Slapton-Leigh), Cornwall (Fowey, Falmouth and Truro), Lanarkshire, Invernessshire, Aberdeenshire and Sutherland; in Ireland in Down, and recently near Shrewsbury.

The adults occur in May, June, July, August, September and October. The majority I have found in Kent in September.

The larvae occur in small pools, ditches, roadside puddles and along the borders of lakes and the backwaters of rivers. I once found numbers in rain-water barrels. They may be found all the winter—the frozen water making no difference to them.

3. *Anopheles nigripes* Zetterstedt. This smaller and much darker species is recorded from Kent, where I took the female at Wye in 1898; it has not since been taken in the county; it is also recorded at Lyndhurst in the New Forest, where Verrall says it is comparatively rare. At Penzance in Cornwall Mr. Terry, late of the British Museum, informed me it was common in 1900 along a stream runing at the bottom of the garden where he was staying. Also found near Shrewsbury (Burton).

I also found it in 1900 in the small shady garden of evergreens in front of the Goat Hotel, at Beddgelert, in Carnarvonshire. Recently an amount of material was sent me from Edinburgh University by Mr. Ashcroft, in which were many of this species taken in Edinburgh and in Manchester.

One female has also been caught in Dublin. Verrall records the adults in Lyndhurst from June and July, the rest were taken in August and September.

It appears to be a sylvan species, and the one I took at Beddgelert was a vicious biter. The larvae have not been found in Britain.

4. *Theobaldia annulata* Meigen. This spotted winged and banded legged Culicid is one of the commonest British species. It bites very severely, especially in certain localities and at certain times. It may be described as a household mosquito, for it occurs in numbers in houses at all elevations, but is especially prevalent in outdoor privies. It also occurs in plenty out-of-doors. It is

usually to be met with in the woods on Worlebury Hill, behind Weston-super-Mare, and is there called the Wood Mosquito.

I have taken females in August, and on right through the winter. The males occur in August, October and November. The females hibernate, the males die after fertilising the females.

Hibernation takes place in sheds and outhouses generally, and in hollow trees, etc., under the eaves of thatched cottages and buildings, and a few in cellars.

The larvae I have found mainly in water barrels and small pools, but they also occur in ditches and dykes. I also once found them in a saucer of water and in a jam pot. They are quite large when mature, being nearly three-quarters-of-an-inch in length; the colour is pale-greyish brown, the siphon is rather thick and short. The pupae have rather curved siphons. The ova are laid in boat-shaped masses.

Their bite is very painful. The consequences of their punctures may take one of three distinct forms, as recorded by Mr. W. Hatchett Jackson* :—

"(1) It is followed by a simple hard swelling, which, however, rises more slowly and disappears more slowly than the swelling caused by any other gnat known to me. It is also larger and traces of it may exist for months.

(2) A swelling arises as above detailed but it is accompanied by a large reddened and puffy area of inflammation. A clear vesicle containing a yellowish lymph develops in the centre of the hard swelling. There is more or less severe itching. If opened, the vesicle draws lymph for three or four days, and the inflammatory area diminishes *pari passu*. Cases have occurred, especially in women, where there have been four or five simultaneous but separate punctures and the patient has suffered so much malaise as to retire to bed with fever ranging up to 101° F.

(3) The hard swelling is slight or absent, but there is great and extensive oedema. A case occurred in the practice of a friend of mine in which there was a puncture on the man's hand; the whole arm inflamed, was extremely painful, with oedematous swelling extending up to the shoulder joint, etc. . . ."

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* "A Monograph of the Culicidae, or Mosquitoes." Vol. III. p. 149, 1903, F. V. Theobald.

Many cases have come to my notice where this mosquito has produced a considerable amount of oedema in Kent.

I have found it in the following localities in Britain :—Budleigh Salterton, Lynmouth, Exeter (11), Okehampton, Worcester, Bath, Clevedon, Hastings, Wye, Canterbury, Faversham, Haslemere, Godalming, Cheltenham, Great Staughton, St. Neots, Par Junction, Lostwithiel, Plymouth, Kingston-on-Thames, Esher, Filey, Epping Forest, Bedford and N.W. London. To these must be added Weston and Glastonbury Plain and Shrewsbury.

Abroad it is found in France, Switzerland (Interlaken), Bulgaria, Portugal, Holland, Belgium, Hungary, California and India.

Besides blood of man it also feeds on plant juices and the blood of the lower animals. It has been seen feeding on the stalks of the periwinkle and young wallflowers at Weston. I have seen it on decaying apples and feeding upon recently dead flies.

Its bloodsucking habits not only have caused great annoyance around Weston and Worplesdon, but have been very noticeable around Canterbury. Mr. Hammond sent me this species which had bitten two people, who had been very ill from the bites.

In 1903, this species was complained of at Worplesdon ; Mrs. Malcolm Thompson, of Brindley Manor, stated that this large mosquito had invaded the house, especially two south-eastern rooms, in great numbers and stated that there was no stagnant water near. Reference was made to their loud buzzing noise and the painful nature of their bite.

In 1903, I made observations* on the hatching of this gnat and I found the imagines hatched out between eight and eleven in the morning. The males nearly all hatched out in the centre of the barrel, the females against the sides. The emergence lasted from August 17th to 27th. They all hatched out between eight and eleven o'clock in the morning. The first few days females alone appeared, then for two days nothing but males and then females again. Many of the males died on the water. They seem to be easily killed by rain when hatching, which is not the case with the females. But none could be found in the house or privies. I caught some in the woods around the house and it seems they first fly to the woods and later on come to habitations.

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* "Monograph of Culicidae or Mosquitoes." Vol. IV. p. 278. 1907.

5. *Grabhamia pulcripalpis* Rondani.

I have only seen this species once from Britain, four specimens having been sent me in 1900, in July, by Dr. Rees, taken in the Albert Dock, Tilbury. It was recorded from Italy and was probably introduced by means of ships coming from Italian ports.

The last hind tarsal segment being pure white makes its identification easy.

6. *Grabhamia dorsalis* Meigen.

This is a very vicious biter. It resembles the former species but the last hind tarsal is not pure white.

It is widely distributed in Europe, being recorded from Scandinavia (Zetterstedt), Holland (Van der Wulp), Berlin (Meigen), Austria (Schiner), Italy (Ficalbi), and Denmark (Staeger). I have also found it at Bruges in Belgium, and at Rouen, in France.

I have notes of its occurence in the following British localities: Aldeburgh, Suffolk (Piffard), Wyre Forest (Bradley), numerous places on the banks of the Thames on the Essex side, Rochester, Albert Dock, London, E., Wye (one female), Exeter, Clevedon, Blackheath, and Greenwich Park.

In 1895 (*Ento. Mo. Mag.*, p. 227), Piffard records this gnat in vast numbers at Aldeburgh, on the Suffolk coast, " where it is known as the Norway mosquito. It seems to have been there for at least twenty-five years. A tradition," says Piffard, " accepted here (Aldeburgh) assigns its introduction to a particular yacht which used to ply between this port and Norway."

This was one of the two species of mosquitoes complained of to the Public Health Department of Greenwich in 1901, owing to the annoyance caused to the inhabitants near there and at Blackheath.

I have also received it from Woodford Green, Essex.

I found it in 1901 in great numbers in the gardens of Dean Hole and Major Newington, close to the Cathedral at Rochester. It was found there breeding in some water collected beneath a tap near the Cathedral. The larvae were also found in abundance in the ditches near the School of Tropical Medicine at the Albert Dock. The larvae are easily told by their short, dark, thick siphon. From various reports sent me I think it occurs all down the Thames valley.

7. *Taeniorhynchus richardii* Ficalbi.

This species is also a vicious biter. It was first brought to my attention in this respect on the Norfolk Broads. Specimens were receved in 1902 from Dr. Long, from Norwich. It has also been recorded from Sutton (Bradley) and I took a single male indoors at Wye in 1902.

8. *Culicada cantans* Meigen.

This is essentially a sylvan species. Its broadly banded (basally) legs at once separates it from the other British species. It appears to bite viciously at eventide and at dusk, in woods, especially in warm weather. Mr. Jeffrey, of Ashford, tells me it mainly attacks the ankles, but will bite anywhere.

It has been found in Britain in the following localities :—Ledbury (Yerburgh), Cambridge, Ashford, Kent (woods north of), Wye, Canterbury, Epping Forest, New Forest, Leamington, Birchington and Colchester. The larvae occur in small woodland pools and even small ditches with very little water in them. Shrewsbury.

9. *Culicada morsitans* Theobald.

This species I described from a female in Mr. Verrall's collection, and the male in the British Museum collection. Verrall's specimens were taken in June and September.

It is closely related to *Culex vexans* Mg. and has been the species probably recorded as *vexans* in this country. The thorax is deep brown, with narrow-curved bronzy-brown scales, with median and lateral indistinct lines of pale creamy scales. Abdomen dull dark brown with fuscous scales and basal creamy yellow bands. Legs unbanded; female ungues equal and simple. In *C. vexans* the ungues are toothed. Found at Great Staughton, Shrewsbury.

10. *Culicada waterhousei* Theobald.

This species has only been found so far in the New Forest and was bred from larvae taken by Mr. C. O. Waterhouse, in March. The locality was Brockenhurst. Regarding the larvae of this species Mr. Waterhouse says, "My attention was first directed to the larva of *C. waterhousei* by the length of time it remained under water without coming to the surface for air. The larva which was of a very pale green, almost always rested in deep water on its back, or in an oblique position. The longest time I ever actually watched it was for half an hour."

11. *Culicada diversa* Theobald.

I described this marked species from specimens in Mr. G. Verrall's collection taken in June at Tunbridge Wells, Kent. The marked thoracic and abdominal ornamentation at once separates this large (6.5 mm.) unbanded legged species.

In 1903, I took two females at Great Staughton, in Hunts and one male. It is common at Shrewsbury.

It has also been taken in the New Forest at Brockenhurst, by Mr. C. O. Waterhouse, and I found a male and female at Wye.

This species was also sent to the Board of Agriculture in 1903, with a note that it had caused annoyance near Bristol for five years. They were thought to have come in manure shipped to Avonmouth.

Specimens were also sent by Lady Henry Somerset, from Higham Hall, Woodford Green, Essex.

Mr. Waterhouse bred out this species from larvae taken in pools in the New Forest.

12. *Culicada lutescens* Fabricius.

A single specimen only has been recorded recently. This I took at Kingston-on-Thames in 1885. But both Stephens and Walker record it as British.

The completely yellow scaled abdomen at once separates it. The species I found around a large piece of water in some numbers at my home and I have a distinct recollection of breeding them from the larvae which were collected around white water lilies growing near the edges of the water.

13. *Culicada nemorosa* Meigen.

This is purely a sylvan mosquito, and bites very viciously towards evening and at dusk. It is very common in many districts and often occurs in vast swarms. Walker (*Ins. Brit. Dip.* III., p. 247, 1856), says of it, " Inhabits woods and does not infest houses like *C. annulatus* and *C. ciliaris*."

It is the same as Haliday's *Culex detritus* (1833). Haliday's MSS. note quoted by Walker, says of this species, " In multitudes during the day among hedges on the sea coast, in the evening, in columns about the tops of the trees, appearing like smoke at the distance of a furlong. It is attached particularly to water-cuts in the neighbourhood of the sea. The Reddish gnat (*C. ciliaris* Linn.)

is more general and enters more into houses, but I have not observed it in such clouds as *C. detritus*."

*C. ciliaris* is *C. pipiens*.

This gnat occurred in enormous numbers in Epping Forest in 1903.

In that year I visited Higham Hall, Woodford Green, Essex, for the British Museum, at Lady Henry Somerset's request, owing to the great annoyance being caused by mosquitoes in the neighbourhood.

Lady Henry wrote that "They are large and extremely poisonous —so much so that almost everybody who is stung have had their limbs swollen and it is extremely painful and disfiguring." My assistant, Mr. F. Lowe, was employed by Lady Henry to undertake the destruction of the pest and in the collections made by him it was found that *Culicada nemorosa* and *Culex pipiens* were the common species. In reporting to me Mr. Lowe stated "In a wood which adjoins the gardens and extends for about half a mile to Higham Lake I saw first a few of the Wood Mosquito (*Culex nemorosus*) and individuals of the Banded Legged Mosquito (*Culex cantans*); then I proceeded towards the pools by the Lodge and Higham Lake, their numbers increased to such an extent that, when forcing my way through the bracken—shoulder high in places—in search of their breeding pools, the Culices rose in clouds and attacked me so viciously and persistently that I had to cover my head with my net."

Further in his report he said, "While at work on the estate, each day from 10 a.m. to 7.30 p.m., *Culex nemorosus* and *cantans* always bit savagely." In the large collection made by Mr. Lowe this was the dominant species.

Lady Henry informed me it was quite impossible to go out after sunset owing to the viciousness of these insects.

It has also been sent me from Scarborough, Exmouth, Norwich and Canterbury. Mr. Waterhouse has found it in numbers in the New Forest. The Rev. E. A. Eaton found it breeding in great quantities in the dykes near the sea at Worthing. I have also taken or seen it at Wye, Weston-super-Mare, Bath, Great Staughton, Ross, Barmouth and Hastings.

The larvae are found in ditches near the sea, and inland in small pools in woods and even along the borders of large lakes.

*Culex salinus* of Ficalbi, is as far as I can see the same, and this occurs in the salt water of marshes.

14. *Culicada ornata* Meigen.

Stephens and Verrall record this as British, but I have never seen a true British specimen.

15. *Culicada lateralis* Meigen.

Stephens and Verrall record it from Shrewsbury (Burton).

Specimens in the British Museum were taken in June.

16. *Culicada nigripes* Zetterstedt. Specimens of this have been found in Devon.

17. *Culicada sylvae* Theobald. This has only been taken by Mr. Bradley in the New Forest in June, 1899.

18. *Culicada terriei* Theobald. A single female taken at Dartford by Mr. Terry in October. It flew at him with evident intention of sucking blood.

19. *Culex pipiens* Linn. This is the common brown household mosquito, and may be said to occur all over the main British Islands. It occurs near and in habitations.

It bites at times very viciously, and in certain years more so than in others.

The larvae are found mostly in water barrels, small pools and ponds and fish tanks near houses, and also in cisterns indoors. The females are found from July to the following May in houses, out-buildings and especially in outdoor privies. At certain times the females can produce a loud drumming noise. The males occur first out-of-doors, and may often be seen dancing in clouds ; later they come indoors and fertilise the females which are going to hibernate.

Mr. Lowe reported this species at Higham Hall as follows :—" The stokehole was next inspected, and when the gardener and self entered and lit candles legions of the ' Common Domestic Gnat ' (*Culex pipiens*) flew out. They covered the walls and roof, though the favourite resting-place seemed to be the lower half of the iron pipe, where they were actually packed, and by passing the hand quickly along after the manner in which one catches flies, a handful could be obtained " ; and further, " A large sink for taking the rain-water from roof of porch, etc., was crowded with larvae and pupae of *pipiens*, and the sides with adults of both sexes." " In a shady way between a screen of two privet hedges leading to a convenience near by, the gnats were on the wing in such numbers that I netted them in thousands and crushed them."

This was the main species which caused such annoyance at Greenwich Park and Blackheath in 1901, and which was brought before the Department of Public Health of Greenwich (8). It was also sent in 1908 as causing annoyance at Exeter (11).

20. *Culex nigritulus* Zetterstedt. I found this small and delicate species, which looks like a pale, small *Culex pipiens*, in large numbers in some half-filled rain-water barrels in my garden at Wye Court in 1900.

It was found in all stages, the males and females flying in crowds over the barrels. None were to be found indoors.

It has not since been seen in the neighbourhood, nor has it been recorded elsewhere outside Scandinavia and Crete.

21. *Aedes cinereus* Meigen. I have only seen specimens of this species in Mr. Verrall's collections, obtained at Wicken Fen, Cambridgeshire. It has also been taken by Mr. Bradley, but I have not the locality.

It is also found in Austria, Sweden, Norway and Italy.

Mr. C. O. Waterhouse has also taken the larvae in the New Forest.

Walker (*Ins. Brit. Dip.* III., p. 243), says, " Rare. Found by the Rev. Leonard Jenyns, in Cambridgeshire, and by Mr. Haliday in the county of Cork."

### *The supposed introduction of Mosquitoes.*

For some time considerable paper talk has taken place about the introduction of mosquitoes from abroad in bananas, especially in regards to the introduction of the Yellow Fever Mosquito (*Stegomyia fasciata* Fabricius). This species is apparently the same as *Culex calopus* of Meigen, which occurs in Spain and Portugal; it has already been recorded by Verrall. This record we consider of very doubtful repute. It is quite unlikely that any mosquitoes which occur in climates where bananas are imported from are likely to survive the voyage ; they certainly would not live in this country, least of all *Stegomyia fasciata*, which does not occur, and will not live, outside 48° latitude.

All the wild talk of introduced mosquitoes has ended when the actual insects have been examined and they have been shown to be only one of our native species. Any possible danger of tropical or sub-tropical forms living here may be discarded.

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# EXTRA BRITISH.

## A Plague of Caterpillars in Rhodesia.

Information was sought from the Rhodesian Museum concerning the Noctuid Moth *Laphygma exempta* Walker.

The town of Bulawayo and the country for some distance around was visited by great swarms of the caterpillars of this moth in December, 1907. So numerous were they that they ate off all the young grass and in addition did a great deal of damage to the mealie crop.

Their larvae were also reported to me by Mr. Andrew Linton, the then director of Agriculture of British East Africa in 1906 as occurring in swarms around Nairobi.

The only practical way to cope with such an outbreak is burning the grass and poisoning with arsenate and meal.

# REPORT

FROM THE

# ANALYTICAL LABORATORIES.

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# SEVENTH REPORT

FROM THE

# ANALYTICAL LABORATORY.

BY

F. V. Darbishire, and
W. Goodwin,

The number of substances analysed in this laboratory from April 1908 to the end of June of this year was 333, of which 218 were samples of milk. These figures are slightly below the average of the past few years, and without doubt many buyers of fertilisers and feeding-stuffs send these articles to an analyst appointed under the Fertilisers and Feeding Stuffs Act if a certificate, which could afterwards be used for legal purposes, is required. The analyses of manures have numbered 70, of which shoddies have been the chief representative.

There have been an increased number of inquiries addressed to the chemical department, particularly on points connected with the composition and uses of artificial manures. The publication of articles dealing with these substances in farming and gardening papers is undoubtedly awakening a much greater interest in the nature of these fertilisers, and a desire on the part of those who use them to know something more of the specific effects of the various materials offered for sale. The newer nitrogenous manures, cyanamide or nitrolim, and nitrate of lime are beginning to arouse an interest in the practical farming world, and it is rather unfortunate that the former of these substances should bear such a variety of names, as this tends to cause some confusion. At the present time one hears of cyanamide, nitrolim or nitrolime, nitrogen lime and lime nitrogen, all of which apply to the same substance or at the most only slight modifications of the original cyanamide. Nitrate of lime or Norwegian saltpetre has not received such a varied nomenclature.

Amongst the inquiries regarding artificial manures it is repeatedly found that the users of some of these substances have failed to grasp the main characteristics of the articles they use, and as a result form a very poor opinion of them. This is particularly the case where the seller has not thought fit to give a little general advice as to the time of application and the necessity of certain conditions of soil, such as a sufficient supply of lime. It is found also that the effect of the different classes of artificial manures is often not borne in mind, and much disappointment would be avoided if the following were noted.

(*a*) That the nitrogen or ammonia in a manure stimulates the vegetative organs of the plant, causing an increase of leaf. An excess of nitrogen is shown in a large rank plant which does not mature in the normal way. Thus growth continues late into the autumn, and the formation of the seed is not accomplished within the normal growing period. The cereal crops grown with a superabundant supply of nitrogenous manure give a lot of straw but a poor return in grain, and there is always the fear of the crop being laid if wet or windy weather comes.

(*b*) Phosphoric acid in a manure acts in the contrary sense to the nitrogen, and tends to hasten the time of maturation of the plant, so that the food present in the plant is transferred to the reserves, *e.g.*, the grain, or tuber, in case of the potato. When, therefore, an increased supply of a nitrogenous manure is used, it should be balanced by some phosphatic manure if the best all round results are to be obtained. Where a plant is grown for its leaf, as in the case of cabbage, an excess of nitrogen, say as in a heavy dressing of nitrate of soda, will often be found to pay.

(*c*) The effect of potash on the plant is to increase the amount of carbo-hydrate material, such as starch or sugar, so that a cereal or root-crop would give a heavier yield if supplied with a sufficiency of potash than it would if there was a lack of this material. This difference would also be shown even though the plant was plentifully supplied with nitrogen and phosphoric acid.

It has been shown that given a sufficient amount of nitrogen and phosphoric acid, the increase in the weight of grain from a cereal crop will be more or less proportional to the amount of potash which is added, provided that there was previously a deficiency.

The same, of course, applies to any other manurial constituent, either nitrogen, phosphoric acid or potash; if any of these are lacking in the soil, then the maximum yield is not obtained until the substance which is deficient is applied.

Another reason for artificial manures not giving the satisfaction that they should is to be found in the failure to apply them at the right time. This is not the place to go fully into the best methods of application, but nevertheless any person who buys an artificial manure is strongly advised, if he has not had previous experience of the article, to get full particulars from the manufacturer as to the way of using it, or to refer to one of the many books dealing with this subject.

## POTASH MANURES.

Now that potash manures come almost exclusively from one source, and their manufacture is carefully carried out, it is only in rare cases that the percentage falls below the guarantee. The consulting chemist to the Royal Agricultural Society (Dr. Voelcker) has recently drawn attention to a potash manure sold as kainit, but which differed from real kainit in its properties. This manure, which contained the usual amount of potash found in kainit—11 per cent.—was up to guarantee, but was objectionable because when mixed with an ammonia salt it caused the liberation, and loss, of ammonia. As kainit and sulphate of ammonia are often used together as a manure, there would almost inevitably be an escape of ammonia if this artificial kainit were used.

## PHOSPHATE OF POTASH.

Four samples of this potash and phosphoric acid manure were analysed, and gave :—

| | Soluble. | Potash. | Phosphoric Acid. |
|---|---|---|---|
| 530*a* | 79.01% | 23.53 | 32.25 |
| 530*b* | 96.57% | 33.98 | 12.21 |
| 530*c* | 80.21% | 24.46 | 38.59 |
| 530*d* | completely | 34.85 | 50.10 |

Only sample 530*d* could be regarded as pure, whereas 530*b* was very deficient in phosphoric acid, and must have been mixed with some potash salt that did not contain phosphoric acid.

Phosphate of potash is never used agriculturally as a manure on account of its high price. It is, however, an excellent food for all plants, and is used in small quantities for growing high-class fruit, vegetables and flowers by the horticulturist.

## NITROGENOUS MANURES.

Two rather unique manures of this class—tortoiseshell dust and tortoiseshell shaving—were received for analysis. These substances are waste products in the manufacture of combs and similar articles. They contained :—

| No. | Per cent. Nitrogen. |
|---|---|
| 466*a* | 12.23 |
| 466*b* | 13.59 |

so are well worth using as a manure. The nitrogen would, however, only become slowly available, and would be most suitable for a light soil, just as horn shavings are.

## SULPHATE OF AMMONIA.

The samples of this manure which were received were found to have a purity of

| Reference No. | Per cent. |
|---|---|
| 564 | 89.52 |
| 608 | 94.39 |
| 618 | 94.73 |

There was no ammonium sulpho-cyanide or other injurious substance to be detected in any case.

## BONE MANURES.

All of these were up to guarantee. No 611 was a meat guano of low grade as regards the ammonia. These meat guanos contain more or less phosphoric acid according to whether much or little bone is ground up with the dried meat. A first-class meat guano would contain 10 per cent. ammonia and phosphoric acid, equivalent to 16 per cent. tricalcic phosphate.

| Reference No. | Nitrogen. | Equivalent to Ammonia. | Phosphoric Acid. | Equivalent to Tricalcic Phosphate. |
|---|---|---|---|---|
| 485 | 2.99 | 3.63 | 14.95 | 32.68 |
| 569 | 3.18 | 3.86 | 1.21 | 2.65 |
| 611 | 5.99 | 7.27 | 16.52 | 36.07 |
| 624 | 5.25 | 6.37 | 15.03 | 32.82 |
| 622 | 3.14 | 3.81 | 14.04 | 30.64 |

No. 569 was really a very poor specimen of guano. It contained hair and pieces of crushed bone.

## FISH GUANO.

The percentages of nitrogen and phosphoric acid in samples of this manure were found to be higher than the average of the past few years. Fish guano is a manure that varies a good deal in composition according to what kind of fish residue it is. In the following samples the prices, as far as could be ascertained, have the unit of nitrogen about equal in value to nitrate of soda.

| Reference No. | Nitrogen. | Equivalent to Ammonia. | Phosphoric Acid. | Equivalent to Tricalcic Phosphate. |
|---|---|---|---|---|
| 483 | 5.48 | 6.66 | 4.62 | 10.05 |
| 596 | 8.94 | 10.85 | 7.48 | 16.34 |
| 629 | 8.63 | 10.48 | 7.75 | 16.93 |
| 630 | 8.35 | 10.14 | 8.05 | 17.57 |
| 664 | 83.5 | 7.74 | 7.69 | 16.74 |
| 667 | 6.37 | 10.50 | 6.98 | 15.23 |
| 668 | 8.65 | 10.93 | 9.60 | 20.95 |
| 680 | 9.0 | 10.41 | 9.60 | 20.95 |
| 692 | 8.57 | 10.34 | 7.32 | 15.98 |
| 697 | 8.52 | — | 10.28 | 22.37 |
| 705 | 5.75 | 6.98 | 5.04 | 11.0 |

## SHODDY.

This popular nitrogenous manure continues to be used in considerable quantities in hop gardens. As the following analyses show, shoddy, with which may be included cloth waste, flock dust, varies very considerably in the amount of nitrogen it contains, the highest grades, that is those containing the most wool (cotton contains no nitrogen), showing about 13 per cent. of nitrogen on analysis. For this reason shoddy should only be bought on the percentage of nitrogen, or ammonia, which it contains (to convert nitrogen into ammonia multiply the former by 1.214, or if the reverse calculation is to be made, multiply the ammonia by .8255).

As the table below shows, most of the samples submitted for analysis were not of the highest grade, but would be described as medium if they contained from 6 to 7 per cent. of ammonia. Samples 570 and 577 were high grade, whilst 563 and 578 would be classed as low grade.

| Reference No. | Nitrogen. | Equivalent to Ammonia. | Water. |
|---|---|---|---|
| Special A | 4.9 | 5.95 | 31.2 |
| 563*a* cloth waste | 3.76 | 4.56 | 7.92 |
| 563*b* | 5.0 | 6.07 | 8.92 |
| 570 | 9.98 | 12.12 | 27.24 |
| 571 | 5.93 | 7.20 | — |
| 568 | 7.32 | 8.88 | 30.91 |
| 565 | 5.06 | 6.14 | 9.28 |
| 577 | 9.89 | 12.01 | — |
| 578 | 4.07 | 4.95 | — |
| 580 | 5.37 | 6.52 | — |
| 588 | 5.21 | 6.32 | — |
| 594 (flock dust) | 4.58 | 5.56 | — |
| 599 | 6.76 | 8.2 | — |

It will also be noticed how very much the percentage of water varies in the different samples.

# MISCELLANEOUS MANURES.

## SEWAGE SLUDGE.

Two samples of sewage sludge were analysed. No. 583 was undried and had the usual properties of this material, whereas No. 702 had been dried before reaching us. The last sample contained a little potash, and was worth the 1s. a load charged for it, but much would depend upon the soil to which it was applied, and the distance it had to be carted.

| Reference No. | Water. | Nitrogen. | Equivalent to Ammonia. | Phosphoric Acid. | Equivalent to Tricalcic Phosphate. |
|---|---|---|---|---|---|
| 583 | 56.58 | 0.61 | 0.75 | 0.713 | 1.54 |
| 702 | — | 2.06 | 2.50 | 1.24 | 2.69 |

## POULTRY MANURE.

Several samples of this manure were received, and in districts where poultry breeding and fattening are prevalent, it is often possible to buy considerable quantities of this material.

| Reference No. | Water. | Nitrogen. | Equivalent to Ammonia. | Phosphoric Acid. | Equivalent to Tricalcic Phosphate. |
|---|---|---|---|---|---|
| 625*a* | 70.14 | 0.78 | 0.95 | 0.43 | 0.59 |
| 625*b* | 55.02 | 1.18 | 1.44 | 0.93 | 1.28 |

The poultry manure also contains potash, and on account of the rapidity with which this and the other constituents of the manure are rendered available for the plant, it is a material worth attention. As, however, the composition of poultry manure varies a good deal according to how the birds have been fed, and the way in which the manure has been collected and stored, it should only be bought in bulk after an analysis has been made of an average sample.

The feeding of meat and ground bone gives a manure which is much more valuable than that got from poultry which are being rapidly fattened, and so receiving a less nitrogenous diet.

For comparison an average analysis of fresh stable manure may be taken to be :—

| Nitrogen. | Equivalent to Ammonia. | Phosphoric Acid. | Equivalent to Tricalcic Phosphate. |
|---|---|---|---|
| 0.390 | 0.473 | 0.180 | 0.399 |

## FEEDING STUFFS.

The cakes and meals sent in for analysis have with few exceptions been found to be satisfactory. In some cases the prices quoted have seemed to be in excess of the feeding value, but the questions of credit, carriage, etc., introduce a difficulty in arriving at a fair price when based upon the chemical analysis alone. Whenever a valuation is made of a cake or other feeding stuff it must be understood to be for cash without any consideration of carriage.

For detailed table see p. 208.

No. 561 was a sample of oat husks, and contained too much crude fibre and too little oil to be a satisfactory food. It was not worth the £3 5s. per ton charged for it. No. 585 was a barley meal made from foreign barley. The botanical analysis showed it to be mixed to a slight extent with weed seeds—black bine and corn cockle.

None of the other samples call for special mention.

## SOFT SOAPS.

Samples of soft soap to be used in the preparation of hop washes were also analysed, and the standard for judging of the value of the soap was the number of pounds which would produce a lather with 100 gallons of the Mid-Kent Water Company's supply, as used in the College Laboratory.

A good soap will give the required lather with 100 gallons of water when 3½ to 4 lbs. are used.

| Ref. No. | Oil. | Protein. | Nitrogen. | Fibre. | Nitrogen Free Extract. | Mineral Matter. | Sand. | Water. | |
|---|---|---|---|---|---|---|---|---|---|
| 489 | — | 26.50 | 4.24 | — | — | — | — | — | Rape Meal. |
| 500 | 3.98 | 15.25 | 2.44 | 4.31 | 59.86 | 3.0 | 0.24 | 12.96 | Middlings. |
| 512*a* | 5.85 | 24.06 | 3.85 | 20.1 | 34.02 | 5.55 | 0.25 | 10.42 | Undecorticated cotton cake. |
| 512*b* | 4.38 | 25.12 | 4.02 | 21.45 | 32.39 | 5.66 | 0.29 | 11.0 | ,, ,, ,, |
| 561 | 1.42 | 5.25 | 0.84 | 30.45 | — | 5.16 | 0.77 | 11.76 | Oat husks. |
| 572 | 10.51 | 19.63 | 3.05 | 8.03 | 40.05 | 6.66 | 0.22 | 14.9 | Compound cake. |
| 582*a* | 6.49 | 23.32 | 3.73 | 26.46 | 28.43 | 6.09 | 0.166 | 9.21 | Egyptian cotton cake. |
| 582*b* | 6.05 | 20.06 | 3.21 | 27.74 | 29.28 | 5.61 | 0.44 | 11.26 | ,, ,, ,, |
| 585 | — | 10.88 | 1.74 | — | — | 5.03 | — | — | Barley Meal. |
| 593 | 4.96 | 24.06 | 3.85 | 21.40 | 31.49 | 5.79 | 0.06 | 12.24 | Undecorticated cotton cake. |
| 613*a* | 4.56 | 34.44 | 5.51 | 9.96 | 33.69 | 10.04 | 0.79 | 7.31 | Decorticated ,, ,, |
| 613*b* | 3.37 | 39.69 | 6.35 | 10.98 | 25.52 | 9.73 | 0.1 | 10.74 | ,, ,, ,, |
| 614 | 4 .44 | 24.76 | 3.96 | 21.58 | 32.86 | 5.28 | 0.12 | 11.08 | Undecorticated. |
| 660 | 3.03 | 16.25 | 2.6 | — | — | 4.45 | 0.92 | 12.38 | Middlings. |

The free alkali present in a soap to be used for washing hops or fruit trees is of importance, for the quantity ought not to exceed a small amount.

| Ref. No. | Lathering Power. | Free Alkali. | Carbonate. |
|---|---|---|---|
| 467*a* | 3 lbs. | 0.42% | — |
| 467*b* | 4.9 lbs. | 0.14% | — |
| 672*a* | 3.17 lbs. | — | 2.92 |
| 672*b* | 3.05 lbs. | — | 2.75 |
| 674 | 14.00 lbs. | — | 24.40 |
| 675 | 5.32 lbs. | — | 10.86 |

Nos. 672*a* and 672*b* contained a considerable quantity of a alkaline carbonate, which indicated that the soaps were old, and all the free alkali had passed into carbonate.

No. 674 was in the form of a powder, and was understood to be a bye-product from the preparation of maize starch. It was sold for washing hops and roses, but as the sample did not dissolve entirely in water even when boiled, it would not be a suitable material for washing with the machine. The sample was further very rich in carbonate, indicating that at one time it contained a lot of free alkali. No. 675 was a sample of soap which had also deteriorated by being kept. It was also made from a bye-product, but was inferior to the ordinary soap.

## MISCELLANEOUS SAMPLES.

No. 522 was a sample of hops, which had been rejected by the brewers on account of the large amount of sulphur which they contained. The analysis showed that 0.8 per cent. of sulphur was present either as free sulphur or sulphur dioxide. In treatises dealing with hops and brewing, 0.1 per cent. is given as the maximum amount of sulphur which should be contained in dry hops.

A further series of analyses of hops showed that those taken directly off the hair contained 0.67 per cent. sulphur, those from the top of a pocket 0.55 per cent., and those from the bottom of the pocket 0.61 per cent.

No. 486 was a liquid which was used as a preservative for butter. It contained 4.5 per cent. boracic acid, and so far as could be ascertained nothing else except water.

## POISONING CASES.

A much larger number of suspected or proved cases of poisoning have to be recorded in this report.

No. 537 was a lamb medicine, which was supposed to have caused the death of a number of lambs, but the analysis did not show any poisonous material, and it is hardly likely that the deaths were due to it.

Two samples of water were also sent in, but in neither was any poison found.

A clear case of arsenical poisoning, in which very large quantities of arsenic were found in the stomachs of a lot of four sheep which had died very suddenly, also came under notice. The owner of the sheep was unable to account for the way in which the animals could have obtained the poison. Judging by the amount it almost looked as though the sheep had been maliciously poisoned, as all inquiries as to the possibility of them having got to any dip or spraying mixture were fruitless.

No. 703 was a case which seems rarely to be met with. A number of valuable calves had died one after another, and the stomach of one of them was sent for examination. The contents of the stomach were remarkable for the large amount of sand contained. The stomach itself was much inflamed, and without doubt this irritation and inflammation had caused death. No metallic poisons, such as arsenic, lead or copper were found in the contents of the stomach, but on getting rid of the organic matter several ounces of clean, sharp sand were left. The sand had all the appearance of road sweepings, but how the young stock came to get such a large quantity has never been solved. The calves were feeding on a field close to the road, and might have picked up a little more sand than usual if the road sweepings had been thrown over the hedge into the field, but the quantity seemed excessive even when allowance was made for that. A sample of road sweepings taken from the locality and treated in exactly the same way as the contents of the stomach had a very close resemblance to the sand got from the stomach.

At the time of writing this article a number of other cases have been dealt with, and although they ought really to be included in next year's report, as they have not yet been completely investigated, reference will be made to them here on account of the urgency of the matter.

During the spring and early summer of the year, a number of deaths occurred amongst sheep which had been grazing in orchards where the trees had been sprayed with mixtures containing metallic poisons such as arsenic, lead or copper. When sprays of this nature began to be first used there were many objections raised to them, particularly against arsenic, because of its well-known poisonous properties. To decide whether or not the use of sprays containing arsenic was dangerous from the point of view of the consumer of the fruit, a large number of investigations were carried out, chiefly in America. The results of these experiments will be judged when it is said that those conducting the experiment came to the conclusion that to be injured by the arsenic on sprayed apples a person would have to eat eight to ten barrels of the fruit. Similarly with grapes sprayed with Bordeaux mixture it has been held impossible for any injury to result to the consumer's health under ordinary conditions. As during the spraying of fruit trees some of the wash must fall on to the grass below, and as it is the custom in some districts, as in Kent, to pasture sheep on sprayed orchards, it was of great importance to know whether injury would be done to animals eating grass upon which some of this poisonous mixture had fallen. The investigations on this point were chiefly directed towards the arsenic. A. J. Cook, in the Annual Report of the Michigan Board of Agriculture, gives an account of the numerous experiments which he conducted in this direction. It will suffice to mention that after feeding the grass from under trees which had been sprayed in the ordinary way with arsenical mixtures, and some of which had dripped on to the grass, he found no injury either to sheep, or to a horse, and the conclusion regarding arsenites is that "in their use there is no danger of poisoning the fruit, and when used properly no danger to the foliage nor to the stock that may be pastured in the orchard."

Experiments carried out by this College and reported in the *Journal of the Board of Agriculture* for September, 1902, showed that using Paris Green there was no injury to sheep fed upon the grass beneath the sprayed trees, although for the purposes of the experiment not only had the trees been sprayed with large quantities of the poisonous liquid, but the grass had also been directly sprayed.

It was held then to be proved that with reasonable precautions the arsenical washes sprayed on to fruit trees could not be injurious to sheep pasturing in the orchards, even though the spraying exceeded the quantity which ought to be used.

The likelihood of Bordeaux mixture leading to cases of poisoning was looked upon as less likely, and almost the only recorded case is where a sheep died after eating vine leaves which had been sprayed with Bordeaux mixture.

When, however, deaths began to occur amongst sheep that had been feeding in orchards in different parts of Kent, it became necessary to investigate the cause, for there was a close agreement in the symptoms as recorded by the veterinary surgeons who had attended the cases. The diagnosis was usually mineral poisoning, and as the viscera was often forwarded to this laboratory, a thorough chemical examination was made. It was expected at the beginning of the inquiry that arsenic would be found in the stomach or intestine, but the analysis failed to bring to light either this poison or lead. Instead, however, considerable quantities of copper were detected in the liver and kidneys, and death was probably due to poisoning by this metal.

When the facts of the various cases which had been brought under our notice were collected, it was found that the behaviour and appearance of the sheep before death was somewhat as follows : One or more individuals of a flock which had been feeding in an orchard of sprayed trees began to show signs of losing flesh, and to become dull and apathetic. This state continued for some time, the animal becoming thinner, but nothing remarkable was noticed until the head began to be carried low and the back depressed. The next stage showed the whites of the eyes to be yellowish in colour, and on handling the animal, there was evidence of pain in the loins. About this time diarrhœa was noticed, but the sheep still continued to feed, although manifestly in a very bad condition. No further characteristic symptoms were noticed, until the urine was seen to have a reddish colour or to be mixed with blood, and usually death followed shortly afterwards, often in the night and near the drinking place.

The post-mortem examination showed that the liver and kidneys were greatly altered, and that the fatty parts of the viscera had acquired a yellowish tinge. In some cases the flesh itself had a yellowish appearance. The liver substance was greatly changed, and had a bronzed granular appearance, somewhat resembling the hard roe of a herring ; it was friable and easily broke when handled. The kidneys were also acutely affected, being almost black in appearance, and quite soft and spongey, whilst there was no difference to be noticed between the cortical and medullary portions. The various portions of the stomach were apparently quite healthy (at the most, slight signs of irritation), and the same applies to the intestine. In some cases a blue line was noticed round the gums.

When the viscera came to be analysed, it was found as previously stated, that the liver and kidneys contained considerable quantities of copper, but neither arsenic nor lead. Neither copper, arsenic nor lead were found in the stomach, although it and the contents were very carefully examined. In view of the facts mentioned above, there seems to be no doubt that the deaths were due to copper poisoning.

Further, in cases examined in this laboratory, where death had been shown to be due to arsenical poisoning, there was always considerable irritation of the lining of the stomach. Inquiries into a number of cases where sheep had died after being pastured in sprayed orchards, brought to light the fact that in spraying the trees an excessive quantity of wash had been used, so that the grass below the trees was soaked with the drippings. Apparently also very little care was taken in some cases to prevent the sheep getting to any liquid which had been spilled on the ground during mixing. Direct evidence that the sheep actually suffered from this lack of care was not obtained, but certainly the necessity of preventing sheep from running such serious risks need hardly be pointed out. Vessels used for mixing the spray and also the place where the mixing takes place should be inaccessible to any domestic animal. That there is a grave danger to sheep feeding in orchards where spraying has been recklessly done will hardly be denied in face of the results of the analyses mentioned above.

Even where precautions are taken and no excessive quantity of spray used, it seems to be quite possible for an animal feeding on fallen leaves which still retain some of the Bordeaux mixture to be injured. One grower has stated that he has seen sheep seek out and eat the leaves which fell, in this abnormal summer, from cherry trees, and the liver of one of these sheep undoubtedly contained copper. Copper being, as is well-known, a cumulative poison, it seems as though the sheep had taken small quantities, and these had gradually accumulated, causing injury to the liver and kidneys, so that death came when these organs could no longer hold out. If this is the case then it is not surprising that no irritation was detected in the stomach, for the quantities consumed would be too small to have a direct effect. One fruit-grower noticed that the whole flock were suffering whilst feeding on a sprayed orchard, and he attributed it to their having got to some spray. He therefore wisely removed the sheep, and they all recovered. In such a case as this the poisoning may be regarded as "direct," whilst a slow accumulation would have an "indirect" effect, and would only terminate fatally when the liver and kidneys could hold out no longer.

It was also mentioned by shepherds that the more robust members of the flock were not attacked or even apparently injured, whereas the weaker sheep suffered most. Further, a flock where the animals were of a weaker constitution and of smaller size, had a large percentage of losses.

There can be no doubt that in the majority of cases the excessive spraying, which caused the grass to be thoroughly soaked with the poisonous mixture, enabled the sheep to gradually pick up enough copper to poison them.

*Note.*

Since the above article was written it has been found in the course of further experiments with the livers and kidneys of sheep that copper is often present in small quantities, even when the sheep have not been pastured on orchards or other places where they would be likely to obtain any of this material. This point is being investigated further to see in how many cases copper is present in the liver or kidneys of healthy, normal sheep. It is also proposed to undertake a practical test of feeding sheep on grass that has received Bordeaux mixture from sprayed trees.

The fact that sheep have apparently been injured by copper used for spraying purposes should cause fruit-growers to exercise caution both in spraying and in preventing stock getting to grass that has been thoroughly wet with any copper solution. As soon as the results of the experiment, which is to be undertaken this spring, are known, they will be published.

## MILK.

The number of samples analysed for butter fat alone was 194, and in addition 24 samples were analysed completely. Of the 218 samples in which the butter fat was determined it was found that 26.2 per cent. were below the legal standard of 3 per cent. This is an average which agrees closely with those of previous years. Unfortunately it is impossible to say what percentage of these milks was from the morning milking, for in most cases no information was furnished by the senders. It would be much more satisfactory, both for the sender of the sample and forthe analyst, if a few particulars were sent with the milk, for often a determination of the butter fat alone is not of much value unless it is considered in conjunction with other points, such as time of milking, whether the sample is mixed milk or from one cow, &c. Where a considerable number of analyses are made each year, there gradually collects a supply of information which would often be of service to the milk producer, and would be given if it were considered applicable to any particular analysis. Where the milk is simply sent without any note as to its origin, the analyst has to content himself with a bare statement of the percentage of butter fat, &c., which has been found. As was pointed out in a previous issue of this Report, it has happened more than once that a modification of the hours of milking or some other slight change has resulted in the average percentage of butter fat in the milk being raised to, or beyond the legal limit.

Another point in the analysis of milk, or rather in the wording of the analysis, is perhaps worth mention here. Often a farmer or milk seller receives a report, perhaps from an inspector under the Sale of Food and Drugs Act, or from an independent analyst, saying that the milk contains so much "added water," or so much "fat has been abstracted." These phrases have rather an unpleasant sound, and in cases where there is no question of the milk having been adulterated they are very apt to cause great annoyance and mistrust of analytical methods, for the seller of the milk may be absolutely certain that no water has been added to the milk or fat abstracted. If the average analysis of milk be taken to be :—

Fat 3.9 per cent.
Protein (Casein, etc.) 3.4 per cent.
Milk sugar 4.75 per cent.
Ash .75 per cent.
} Total solids 12.9 per cent.
Water 87.10 per cent.

then the "total solids" or dry matter compose 12.9 per cent. of the whole, and the remainder, 87.10 per cent., is water. If the fat is deducted, there remains 9.0 per cent. for the "solids not fat."

H. Droop Richmond, under whose direction a very large number of milk analyses have been made, states that only 2.19 per cent. of the samples which came under his notice contained less than 8.5 per cent. of solids not fat. If, therefore, the total solids are estimated in a sample of milk and also the fat, then, after deduction of the latter, the solids not fat ought not to fall below 8.5 per cent. This figure (8.5) has been fixed by the Board of Agriculture as the legal standard for solids not fat, or as they term it, "milk-solids other than milk-fat."

If, then, milk had been adulterated by the addition of water, the solids not fat in a given volume would fall below 8.5 per cent., and the analyst would not regard the sample as genuine, but as having been adulterated. By means of a simple calculation, he would then state how much water he considered had been added to the milk. If it were possible to obtain some of the original milk before adulteration, then an analysis of that compared with the analysis of the adulterated sample would enable him to say definitely what percentage of added water was present in the latter. As, however, it is never, or almost never, possible to get any of the original milk, the figures which have been found as the average of a very large number of samples have to be taken, and, as has been seen above, 8.5 per cent. is the figure obtained for the solids not fat, and this amount is regarded as the limit for legal purposes ; any milk that contains less is held to be adulterated unless proof to the contrary can be furnished.

Suppose then a sample of milk on analysis showed the total solids to be 11.0 per cent., and the fat 2.8 per cent., this would leave $11.0 - 2.8 = 8.2$ per cent. for the solids not fat. By means of the formula

$$100 - \frac{S \times 100}{8.5^{*}} = \% \text{ added water; where } S = \text{solids not fat,}$$

the analyst would get

$$100 - \frac{8.2 \times 100}{8.5} = 100 - 96.4 = 3.6\ \% \text{ added water.}$$

The analyst's report would therefore state, if the calculation had been made according to the above formula, which is the usual one in this country, that the milk contained 3.6 per cent. added water.

Similarly a limit has been set for the amount of fat present in milk which is offered for sale. The Board of Agriculture have fixed the legal standard as 3 per cent. butter fat. Milk which contains a less amount than this is regarded as not being genuine, owing to the abstraction of fat. This figure, 3 per cent., is taken as the average of a large number of analyses, but in many cases of genuine milk it will be found that where the intervals between the milkings are very disproportionate, the milk drawn after the longer interval

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[*] Sometimes 8.9 is used to calculate the probable amount of added water ; this would give 9 per cent. of added water in the above case.

is much poorer in butter fat. If, for example, the cows are milked at intervals of fourteen or fifteen hours and ten or nine hours, it is almost certain that in the milking which succeeds the longer interval the fat will fall below 3 per cent.

Further, that genuine milk, from a medium-sized herd of cows, can fall below the Government standard of 3 per cent. was shown very clearly in the case quoted in last year's Report, No. 6, p. 22, where the mixed milk of ten cows only averaged 2.87 per cent. of fat in the mornings. As in this particular case a member of the College staff was present during milking, and afterwards weighed, sampled and tested the milk, the accuracy of sampling and analysing can be vouched for.

Taking then the analysis of a milk such as has been used as an example in showing how the added water is calculated, we see that 2.8 per cent. of fat is present. To find how much fat would be regarded as having been extracted, the analyst would use the formula

$$100 \frac{f_1 - f_2}{f_1}$$

where $f_1$=fat in the original milk

$f_2$= fat in the sample analysed.

As the fat in the original cannot ordinarily be determined, the legal minimum of 3 per cent. is taken for $f_1$ so that now

$$100 \frac{3 - 2.8}{3^*} = 6.6\ \%$$

The analyst's report would state that 6.6 per cent. of fat had been abstracted, and unless the seller of the milk could prove, which is a difficult thing to do, that the milk was genuine, he would be liable to prosecution for infringement of the Sale of Food and Drugs Act.

The regulations under which legal proceedings are taken state that " The Board of Agriculture in exercise of the powers conferred on them by Section 4 of the Sale of Food and Drugs Act, have made the following regulations :—

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* In calculating the amount of fat that has probably been abstracted 3.9 may preferably be used, which gives 25 per cent. abstracted fat in the above case.

### " MILK.

" (1) Where a sample of milk (not being milk sold as skimmed, or separated, or condensed milk) contains less than 3 per cent. of milk-fat, it shall be presumed for the purposes of the Sale of Food and Drugs Act, 1875 to 1899, until the contrary is proved, that the milk is not genuine by reason of the abstraction therefrom of milk-fat, or the addition thereto of water.

" (2) Where a sample of milk (not being milk sold as skimmed or separated, or condensed milk) contains less than 8.5 per cent. of milk-solids other than milk-fat, it shall be presumed for the purposes of the Sale of Food and Drugs Act, 1875 to 1899, until the contrary is proved, that the milk is not genuine by reason of the abstraction therefrom of milk-solids other than milk-fat or the addition thereto of water.

" (6) These Regulations may be cited as the Sale of Milk Regulations, 1901."

# SOYA BEAN CAKE AND MEAL.

By V. S. Rawson and W. Goodwin.

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During the last year or two soya bean cake and soya bean meal have been used to a very considerable extent in this country, and they are now quite familiar feeding-stuffs to most farmers and cattle breeders.

The soya beans, called also soy and soja beans, from which the cake and meal are made, come chiefly from Manchuria, where large quantities are grown for human consumption and for the feeding of animals. Owing to the accumulation of these beans in the Far East, and the consequent lower price, particularly when freights from the country of origin to home ports are low, makers of oil cakes have been able to import the beans and make them into cake. This soya bean cake, the meal also, is very rich in food material and is, as far as all evidence goes, a palatable and suitable material for all classes of stock.

The oil, which is extracted from the soya beans in the manufacture of the cake, is used for making soap, or when refined, for edible purposes. It has a slight flavour of the bean, but not unpleasantly so, and it will probably be used instead of cotton seed oil for many purposes.

The richness of the soya bean cake in nitrogenous matter (protein) is easily accounted for when it is known that the soya beans are leguminous seeds, that is to say, of the same natural order as our common beans. All the seeds of this order—peas, beans, lupins, lentils, etc., are very rich in protein, and are largely used for giving the requisite amount of nitrogen to a ration.

A sample of soya beans which were sent to the College from Manchuria, were found on analysis to contain :—

| Water. | Oil. | Protein. | Nitrogen Free Extract. | Fibre. | Ash. |
|---|---|---|---|---|---|
| 12.15 | 13.80 | 37.20 | 29.58 | 2.40 | 4.87 |

whilst ordinary beans contain on an average :—

| Water. | Oil. | Protein. | Nitrogen Free Extract. | Fibre. | Ash. |
|---|---|---|---|---|---|
| 14.0 | 1.5 | 25.0 | 48.0 | 7.0 | 4.5 |

It will be seen at once that the soya beans are exceedingly rich in protein and oil, and that compared with the ordinary horse bean there is almost as much again of protein. A far greater difference is shown in the percentages of oil in the two cases, for the soya beans have nearly ten times as much. In analyses made in other laboratories, the percentage of oil has been found to be as much as 17 per cent., but the beans which we received contained less, as the above analysis shows.

The amount of oil is too high for ordinary feeding purposes, and if the soya beans themselves were used, the digestive organs would most probably be upset. After the oil has been extracted by hydraulic pressure in the usual way adopted in making oil cakes, there remains some 6 per cent. of oil.

A consignment of soya bean cake sent to the College Farm in January of this year gave the average composition to be :—

| Water. | Oil. | Protein. | Nitrogen Free Extract. | Fibre. | Ash. |
|---|---|---|---|---|---|
| 14.00 | 5.89 | 45.70 | 24.81 | 2.60 | 7.00 |

Of the 45.70 per cent. crude protein contained in the cake, 44.67 per cent. was found to be true protein when analysed by Barnstein's* modification of Stutzer's method for the estimation of true protein

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* Landw. Versuchs-stationen, 1900, 54. 327.

(albuminoids) in feeding stuffs. It was proposed to determine the digestibility of the soya bean cake by direct feeding experiments with sheep, but the trial had to be abandoned owing to the difficulty of getting the sheep to eat up all the ration when kept in close confinement. Recourse, therefore, was had to an artificial determination of digestibility in order to get some idea of the digestibility of the nitrogenous portion of the soya bean cake. This was of importance, because in beans some of the protein is not easily digested, and it might easily be that in a cake made from the soya beans a considerable quantity of the protein would be valueless through not being digested. In fact, a large proportion of undigested protein would greatly diminish the value of this food.

The method employed in ascertaining the digestibility of a food by artificial means is due to Stutzer, who in 1880 proposed to test feeding stuffs by digesting them with gastric juice and then with pancreatic juice. Thus digestion was carried out at a temperature about the same as that of the body, and the process on the whole was an attempt to imitate the action of the digestive organs. When the feeding stuff had been treated for a certain length of time, the undissolved material was filtered off, washed and weighed, and so the amount that had been dissolved—in other words, digested—was easily calculated.

Where the experiments all followed the same method, comparative results could easily be obtained, and a good many analyses were made in this way. The method, however, was tedious, and not very easy to carry out, owing to the difficulty of preparing the digestive solutions in a satisfactory manner. A great improvement in the method of artificial digestion is due to Wedemeyer, who employed ordinary pig's pepsin and very dilute hydrochloric acid instead of gastric juice extracted from the stomach. The digestion with pancreatic juice has been dropped, and the method as now carried out is as follows :—

The finely ground food is allowed to stand in contact with pepsin and dilute hydrochloric acid for forty-eight hours at body temperature, or say 100° F. ; then the liquid is filtered off and the residue after being washed with alcohol and ether, is analysed for the amount of nitrogen it contains. In this way knowing the amount of nitrogen in the original food-stuff, and knowing the amount in the undigested portion, it is easy to calculate how much nitrogen has been artificially digested. As is usual in this kind of work, the percentage of nitrogen × 6.25 is known as protein.

Digestibility experiments carried out on the above lines by us showed that soya bean cake was very digestible as regards the protein, for out of 100 parts 89.68 parts were digested. This figure is slightly higher than that obtained for soya beans themselves in the Wisconsin University Experiment Station, where the digestibility trials were with animals, and the percentage of digested protein was 87 per cent. To see if any difference existed between the soya bean cake and the beans themselves, an artificial digestibility trial was made with the latter, and following the same method very exactly, the digestibility co-efficient came out at 89.09 per cent.

Thus the cake and the beans behave alike towards artificial digestion, at least under the conditions which were observed in this particular series of experiments.

It is not possible to determine the digestibility of the other constituents of feeding-stuffs by artificial methods, but as the analysis of the soya bean cake shows only a moderate quantity of oil and little fibre, there is no reason for thinking, especially in view of feeding trials conducted in this College (see next article), and in other places, that it contains anything that would affect animals disadvantageously.

Soya bean cake has, however, one drawback, and that is its hardness. It was noticed on the College Farm that sheep seemed to find difficulty with it on that account, and the mouths of the lambs became very tender. As there is now a soya bean meal on sale, some of it was bought and fed to the sheep in place of the broken cake.

The analysis* of the meal was

| Water. | Oil. | Protein. | Nitrogen Free Extract. | Fibre. | Ash. |
|---|---|---|---|---|---|
| 11.79 | 5.57 | 42.91 | 29.70 | 4.53 | 5.50 |

---

* Mr. R. H. Carter kindly made this analysis.

This material was, therefore, simply ground soya bean cake, and was not a meal from which the oil had been extracted by some solvent. Where soya beans have been made into meal and extracted with a solvent such as petroleum ether, only some 1½ to 2 per cent. of oil remains. It is well, therefore, to note that there are such differences, and an extracted meal has not the same feeding value as a meal made by grinding up cake.

The soya bean meal gave very good results with both sheep and lambs, and as it is a very concentrated food, it should be used in moderation.

# TRIAL OF SOYA BEAN CAKE.

BY J. MACKINTOSH AND W. GOODWIN.

The first consignment of this food-stuff arrived at the College Farm in January of this year, and small quantities of it were at once fed to all classes of stock. Cows, fattening bullocks and sheep all ate it readily, and gave no sign that it affected them adversely in any way. Later on it was found to be somewhat unsuitable for lambs, owing to its hardness, but this difficulty was overcome by using the soya bean meal.

In March an experiment was devised in order to test the value of the cake as a food for milk cows, and its effect on the quantity and quality of the milk, and on the texture and flavour of the butter produced.

Three cows were set aside for the purposes of the experiment, and for a period of three weeks these were fed the following basal ration :—

50 lbs. mangels.
3 lbs. dried grains.
2 lbs. maize germ meal.
The mangels were cut and mixed with the grains and meal before feeding.
12 lbs. hay.
3 lbs. undecorticated cotton cake.

For the next period of three weeks soya bean cake was substituted for the undecorticated cotton cake, and a similar quantity given. Owing to its greater percentage of protein (albuminoids) 3 lbs. soya cake are more than equivalent to 3 lbs. undecorticated cotton cake, but this quantity was adhered to, as it is about the quantity likely to be fed in practice, and the aim of the experiment was to find out the practical effects of the food.

For the six weeks through which the experiment ran, the milk from each cow was weighed, sampled, and tested for the percentage of butter fat daily, then separated and butter made from the cream obtained. The Reichert-Meissl number was then determined in a sample of the butter, to see whether the fat changed in composition when the soya bean cake was being fed.

The live weights of the cows were taken during the first week, and again in the sixth week.

The results obtained are stated and discussed in Table I. on page 227.

The last column in the table shows the rise or fall in average daily yield of the second period compared with the first. The only inference which can be drawn from these figures is that the soya bean cake is a satisfactory food, but without any noticeable effect on the yield of milk. The slight differences noted are only such as would be expected from the individual variations found in the yield of dairy cows, and the slight decrease due to the advance in the lactation period.

For average daily percentage of fat see Table II. on page 228.

As in Table I. the last column shows the average rise or fall in the second period compared with the first, and in this case also the results are negative. The rise in quality is slight, and only such as would occur in the advance of the period of lactation ; in the case of cow No. 22 L. the fall in quality is another illustration of how the amount of fat may vary in a short space of time.

The fact of the morning's milk being in almost every case under 3 per cent. fat is accounted for by the fact that the intervals between the milking are distinctly unequal ; the milking hours are 5.45 a.m. and 3.15 p.m., giving intervals of 14½ and 9½ hours. There is only one instance (Cow No. 11 S, Period I., second week) of the average of morning's and evening's milk being below 3 per cent. fat.

*Effect on the butter.*

There were six churnings of cream in the first period, and five in the second, and the whole process of churning, etc., was carefully observed for any differences which might be attributable to the food.

TABLE I.—SHOWING AVERAGE DAILY MILK YIELD IN LBS. DURING THE TWO PERIODS.

| | | Period I.—Basal Ration. | | | | Period II.—Soya Cake Ration. | | | | Gain + or Loss — on Period I. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | First Week. | Second Week. | Third Week. | Average. | First Week. | Second Week. | Third Week. | Average. | |
| Cow No. 10 S. | Morn. .. | 14.50 | 14.57 | 14.43 | 14.50 | 13.57 | 13.57 | 14.07 | 13.73 | — .87 |
| | Even. .. | 9.96 | 9.75 | 9.12 | 9.61 | 8.78 | 8.46 | 9.89 | 9.04 | — .57 |
| Cow No. 11 S. | Morn. .. | 13.89 | 13.50 | 13.53 | 13.64 | 14.07 | 14.00 | 14.42 | 14.16 | + .52 |
| | Even. .. | 10.46 | 10.18 | 9.57 | 10.07 | 10.60 | 10.39 | 10.07 | 10.35 | + .28 |
| Cow No. 24 S. | Morn. .. | 13.75 | 14.32 | 14.32 | 14.13 | 13.32 | 13.68 | 14.82 | 14.10 | — .03 |
| | Even. .. | 11.38 | 10.21 | 10.00 | 10.49 | 9.39 | 8.35 | 9.28 | 9.0 | — 1.49 |

TABLE II.—SHOWING AVERAGE DAILY PERCENTAGE OF FAT IN THE MILK OF THE TWO PERIODS.

| | | Period I.—Basal Ration. | | | | Period II.—Soya Cake Ration. | | | | Gain + or Loss — on Period I, |
|---|---|---|---|---|---|---|---|---|---|---|
| | | First Week. | Second Week. | Third Week. | Average. | First Week. | Second Week. | Third Week. | Average. | |
| Cow. No. 10 S. | Morn. .. | 2.67 | 2.58 | 2.37 | 2.54 | 2.75 | 2.78 | 2.62 | 2.71 | + .17 |
| | Even. .. | 3.62 | 3.57 | 3.55 | 3.58 | 3.83 | 3.89 | 3.63 | 3.78 | + .20 |
| Cow. No. 11 S. | Morn. .. | 2.46 | 2.28 | 2.65 | 2.46 | 2.58 | 2.75 | 2.75 | 2.69 | + .23 |
| | Even. .. | 3.76 | 3.50 | 3.85 | 3.70 | 3.86 | 3.77 | 3.40 | 3.67 | — .03 |
| Cow No. 24 L. | Morn. .. | 2.84 | 3.02 | 2.83 | 2.89 | 2.70 | 3.13 | 2.76 | 2.86 | — .03 |
| | Even. .. | 4.30 | 4.00 | 3.78 | 4.02 | 4.10 | 3.81 | 3.50 | 3.80 | — .22 |

In no particular could any direct effect be noticed on or after the change of food, and the butter made from the milk obtained in Period II. resembled in every way that made during Period I. The colour, consistency and flavour were those usually associated with butter produced during the time when the cows are fed indoors on winter rations.

*Effect on the Reichert-Meissl number.*

A sample of butter was taken from each churning, and the determination of the Reichert-Meissl number made in the usual way. It was hardly expected that during such a short period the feeding of soya bean cake would affect, to any great extent, the chemical composition of the butter fat. This was confirmed by the figures given below, and although it is seen that the introduction of the soya bean cake did evidently cause the Reichert-Meissl value to increase, this increase was not very large, and a longer period of investigation would be necessary to allow of a definite statement being made.

The Reichert-Meissl number certainly did not diminish, and therefore in that respect the cake has no drawbacks.

| | Reichert-Meissl Number. |
|---|---|
| April 3rd | 29.92 |
| ,, 7th | 29.87 |
| ,, 9th | 28.76 |
| ,, 12th | 27.34 |
| ,, 16th | 28.60 |
| ,, 20th | 27.94 |
| Average | 28.84 |
| April 23rd | 28.87 |
| ,, 27th | 30.63 |
| ,, 29th | 29.42 |
| May 5th | 29.09 |
| ,, 8th | 30.36 |
| Average | 29.67 |

*Live Weights of the Cows.*

| | First Week. | | | Sixth Week. | | | Gain or Loss. | | |
|---|---|---|---|---|---|---|---|---|---|
| | cwts. | qrs. | lbs. | cwts. | qrs. | lbs. | cwts. | qrs. | lbs. |
| Cow No. 10 S. .. .. | 10 | 0 | 0 | 9 | 2 | 24 | — | 1 | 4 |
| ,, No. 11 S. .. .. | 9 | 1 | 8 | 8 | 3 | 11 | — | 1 | 25 |
| ,, No. 24 L. .. .. | 12 | 0 | 26 | 11 | 3 | 0 | — | 1 | 26 |

It will be noticed that all the animals lost weight during the six weeks of the experiment, but in no case was the loss sufficiently great to prejudice one against the soya cake.

The above figures are the averages of weights obtained on three successive days, and when it is stated that, in spite of careful weighing at the same time each day, there were daily differences of from 3 to 35 lbs. per cow, it will be seen that the loss of weight stated above is of no account.

*Conclusions.*

Soya bean cake is a good and palatable food for milk cows, and is eaten readily. When fed to the extent of 3 lbs. per head per day along with other food-stuffs, it has no noticeable effect on the quantity or quality of the milk produced, or on the flavour, colour or consistency of the butter.

As regards its effect upon the chemical composition of the fat, no changes worth attention were shown in the Reichert-Meissl number.

It may therefore be looked on as a satisfactory, and at its present price, an economical addition to the list of concentrated foods available for the feeding of dairy stock.

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# BOTANICAL DEPARTMENT.

## ECONOMIC MYCOLOGY.

By E. S. Salmon, F.L.S.

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## EXPERIMENTS ON HOPS.

By E. S. Salmon, F.L.S.

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# INTRODUCTORY NOTE.

A large number of plants affected with various fungus diseases have been received during the past season. In the majority of cases these have been diseases of such common occurrence as apple and pear "scab," "brown rot," "canker," rusts, smuts, the various "leaf-spots" of greenhouse plants, and so forth. A large number of gooseberry shoots suspected of being infested with American Gooseberry Mildew have been sent in by growers in Kent, Surrey, and other counties. In these cases, information as to the life-history of the particular fungus causing the disease, and as to the best remedies known to combat it, has been supplied to the grower. In some cases the disease sent in has not been so well-known, and the life-history of the fungus has not yet been worked out; in such cases investigations have been and are being made. With regard to two such diseases, the "die-back" of the gooseberry, and the "rot" of stored mangolds, information is now given (see p. 321 and p. 330).

Advice has also constantly been sought on such practical matters as the best type of spraying machinery for the garden, plantation, and orchard; the type of nozzle suitable for various sprays, and the best method of making fungicides. The fact also that the advice of the College is now being sought by many growers before expending their money on proprietary washes advertised as having fungicidal properties, is a promising sign. In some cases growers are advised to use such proprietary washes; in the majority of cases they are furnished with scientific reasons showing either that such washes are absolutely useless or inferior to the home-made article. Advice has been sought also by the Agricultural Departments of several foreign countries on the subject of "wart disease" of potatoes. At the time of the recent discovery of potato "blight" (*Phytophthora infestans*) in Australia,—a country hitherto free from this disease—information was applied for as to the best measures to be taken.

Apple growers in Kent and Surrey are slowly but surely finding out the great value of home-made Bordeaux mixture for keeping their crop free from "scab" or "black spot." As a spray for this purpose, and also against fungus diseases generally, it is far more efficient, properly used, than any other fungicide known. Improperly made or applied, however, some amount of injury is liable to appear on the leaves or fruit of apples. Even when properly made the mixture is, in certain seasons and on certain varieties of apples, liable to cause some amount of injury. In the wet season of 1909 this injury was pronounced in some districts, and shows that in England—as in other countries—fruit-growers will have to exercise some judgment in dealing with different varieties of apples. A general account of the amount and form of injury that has occurred, together with the best precautions to take to prevent its occurrence, is given below at p. 255. Where in a normal season the use of *properly-made* Bordeaux mixture has resulted in marked injury,—as has happened in the case of Cox's Orange Pippin—a trial on an experimental scale should be made of the form of lime-sulphur wash *for summer use.** The use of a lime-sulphur wash *in winter* can be of little, if of any, efficacy against fungus diseases. For *general* use in summer against "scab," Bordeaux mixture is still undoubtedly the best fungicide known. It should be noted as a fact of great interest to fruit-growers that through a recent chemical discovery made by Mr. S. U. Pickering, F.R.S., Bordeaux mixture in a satisfactory chemical and physical condition is now for the first time able to be prepared *as a paste.* This paste, which has been put on the market under the name of the Woburn Bordeaux paste,† must not be confused with the various so-called "Bordeaux mixtures" *in powder form, e.g.*, Strawsonite, which are quite different both chemically and physically, and which cannot be recommended to fruit-growers. While I have not seen, so far, such good results obtained with the Woburn Bordeaux paste as with home-made

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* Directions for preparing this wash can be obtained on application to the Secretary.

† Sold by Voss & Co., Glengall Road, Millwall, London, E.

Bordeaux mixture, it is certainly a preparation which should be tried *experimentally* by fruit-growers (see p. 248).

During both 1908 and 1909 the relative efficacy of Bordeaux mixture and Burgundy mixture for the prevention of potato " blight " was tested on a considerable scale on the College farm. In both seasons proof has been obtained that it pays well to spray potatoes against " blight " ; in both years the unsprayed " blighted " control plots, contrasted with the sprayed plots on either side, gave convincing proof to the farmers who visited the College of the value of spraying. Similar experiments will be repeated in 1910, and then the general results of the three years' experiments will be described in this *Journal*, and in a Leaflet for distribution.

During 1909 two cases of the reported poisoning of sheep in orchards sprayed with Bordeaux mixture were investigated. In one of the cases, in North-West Kent, many of the trees which had been sprayed twice (after the blossom had fallen) with Bordeaux mixture lost a large number of their leaves, which fell on to the grass beneath. These leaves, which were yellowing and still covered with the mixture, were eagerly sought for by the sheep in the orchard, and eaten by them. Some of the sheep died, and on a chemical analysis being made copper* was detected in the liver. In the other case, which occurred in the Weald of Kent, several sheep on different farms in the district died, the total number being estimated at between thirty and forty. These sheep had been grazing in orchards which had been heavily sprayed with Bordeaux mixture, to which in some cases arsenate of lead had been added. It was thought at first that poisoning through arsenic had occurred, but an examination of several dead sheep revealed no trace of arsenic. Copper, however, was found to be present in considerable quantity in the livers of these animals.† In the cases in question, the spraying had been carried out in a somewhat unorthodox fashion,—that is to say, instead of the Bordeaux mixture having been applied in a fine " misty " spray, the trees had been heavily sprayed or even drenched by the use of nozzles throwing a heavy jet-like spray. As a result the grass, both under the trees and also, to some extent, between the rows, became covered with a more or less thick coating of Bordeaux mixture. In one or two cases, further, the Bordeaux mixture had been made in the orchard, and had been splashed over the grass round the mixing place.

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* Bordeaux mixture is made of copper sulphate and lime.

† See the report from the Analytical Laboratories in this Journal, p. 213.

The presence of a considerable amount of copper in the livers of these sheep seem to indicate that *under the circumstances described above* there is some danger of sheep being poisoned by Bordeaux mixture. It is impossible at present, however, to speak with certainty on this point, for the following reason. After the investigation of the above cases had been made, I applied to the United States Department of Agriculture for information as to whether any cases of the poisoning of stock through Bordeaux mixture had occurred in America, where this spray has been in extensive use now for many years. With their unfailing courtesy this Department immediately placed all the information they had at our disposal. It appears that no *definite cases* of sheep having been poisoned in that country by such means have been recorded. Professor B. T. Galloway, Chief of the Bureau of Plant Industry, wrote further, " I may say that personally I have never known of any authentic cases of injury to animals from the taking of copper on grass or leaves. You mention the fact that a considerable amount of copper was found by your chemist in the liver of the sheep killed. *I believe it is quite common to find considerable quantities of copper in livers of sheep and other animals under natural and normal conditions.*" On receipt of the above information investigations were made by the Analytical Department of this College (see p. 215), with the result that the above statement was found to hold good with respect to the livers of sheep in this country.

Whilst previously there has been no reason—judging from the experience of countries where Bordeaux mixture is in constant use by fruit-growers season after season—to apprehend any danger to stock from feeding in orchards where the trees have been sprayed, the facts mentioned above would now seem to indicate that caution must be taken in allowing sheep to feed either on grass which has received a heavy spraying of Bordeaux mixture, or on leaves covered with this mixture which have fallen to the ground. Experiments in which sheep are fed on grass heavily sprayed with definite quantities of Bordeaux mixture will be made during 1910.

Various matters in connection with the carrying out of the "American Gooseberry Mildew Order" in Kent, and the search for and discovery of this mildew in Surrey and Essex (see p. 412) have necessitated the expenditure of a considerable amount of time. The Kent County Council with their staff of efficient Local Inspectors are now in a position to give a thorough trial of the measures embodied in the "Order," and to ascertain whether they are sufficient to stamp out in Kent this recently-introduced and most destructive pest.

Another matter which has demanded attention is the continued spread of "wart disease" of potatoes. Many steps have had to be taken to endeavour to draw public attention to the great danger now threatening potato growers in Great Britain. The formation of a "Plant Diseases and Insects Pests Committee" of the Central and Associated Chambers of Agriculture has now made it possible to send in to the Board of Agriculture recommendations on the subject of plant-pests which directly embody the wishes of the farmers of this country. By means of various scientific and agricultural correspondents, information on points connected with "wart disease," as well as specimens in all stages of attack, have been obtained. By means of the latter, inoculation experiments have been carried out to test various points. The information obtained shows that a most serious state of affairs now exists in consequence of the spread of "wart disease" in Great Britain. This information is given below at p. 295.

Whilst the control of the great majority of plant pests must be undertaken by growers *individually* (to whom it is the duty of Agricultural Colleges to supply scientific knowledge on the subject of the life-history and the control of each of these pests), it must be remembered that the fruit-grower or farmer is absolutely dependent on State action if his crops are to be protected *from new or recently-introduced diseases*. It is only by official measures promptly enforced by the Agricultural Authorities that any disease when once introduced can be prevented from spreading through Great Britain.

It is natural, for the reasons given in the last number of this *Journal*, that Wye College should be specially interested in the administration of the "Destructive Insects and Pests Act," passed into Law on July 4th, 1907. It is only if properly administered that this Act can accomplish its important work, viz., the stamping out of new plant diseases before they have spread through the country. It is an encouraging sign that an increasing number of fruit-growers are realising the necessity of not only co-operative action among themselves, but also of more efficient action by an Agricultural or Horticultural State Department to protect their crops from new pests. With regard to "American Gooseberry Mildew," fruit-growers are now paying a heavy price as the result of inaction continued over many years, and ratepayers in the counties affected are now beginning to ask for assistance from the Imperial funds to help them to meet the heavy expenses which are being incurred (see p. 287). But the situation is a hundred times more serious with respect to the new potato disease,—"wart disease" or "black scab." From the information which is given below at p. 297, it can hardly be doubted that very grave losses are about to be caused to potato growers generally.

Already the fact that "wart disease" is firmly established in many potato-growing districts—and that no serious attempt is being made to eradicate the disease, and no attempt whatever to deal with the source of its continued spread by stopping the sale of diseased crops—has very rightly caused importers in foreign countries to look with suspicion on potatoes sent out to them from Great Britain. Counties in which no disease exists fall equally under suspicion, and have to suffer, because no map, or detailed information, showing the exact position of the present infected area has been officially published. The publication of this information was asked for by the Central Chamber of Agriculture in 1908. There is evidence that serious monetary losses have already occurred through the prohibition (owing to the danger of "wart disease") of the importation of British-grown potatoes into certain countries.

Some years ago I pointed out that this "wart disease" was likely to prove the most serious fungus pest of the potato, and gave instances where the entire crop in allotments had been destroyed.* The grave losses caused to the potato-grower on a

* See this *Journal*, vol. xv. (1906), and vol. xvii. (1908).

small scale are now beginning to attract general attention. The soil of many allotment grounds in several counties has become so seriously infected that potatoes can no longer be grown in it. Throughout certain districts in some counties the same is true of the soil in many cottage gardens. I have been told of a well-authenticated case in which a farm-labourer, whilst refusing to give any reason whatever, notified his wish to leave his cottage, and removed to one in a fresh district ; the fresh tenant soon discovered the reason,—the soil of the garden had become so infested with the "spores" of "wart disease" that potatoes could not be grown there. In spite of all warnings, no collective action has been taken by, or on behalf of, the small growers of potatoes to protect their crops ; *now that the disease is spreading to farm-lands* it remains to be seen whether farmers and agriculturists generally will make a concerted attempt to deal with the disease.

In 1903 the Departmental Committee drew up the following as its first and chief Recommendation : "That a special sub-Department of the Board of Agriculture and Fisheries be established to deal with matters connected with the fruit industry." It is a surprising fact, and one indicative of how little organised the industry is in England, that fruit-growers as a body have not taken steps to have this most necessary reform carried out.

# On the Making and Application of Bordeaux Mixture; with Notes on "Bordeaux Injury."*

(PLATES I TO 23).

*I.—The making of Bordeaux Mixture.*

Bordeaux mixture for spraying fruit-trees generally (excluding peaches), should be made according to the following formula and in the following manner :—

| | |
|---|---|
| Copper sulphate (" bluestone ")† | 4 lbs. |
| Quicklime (in lumps) .. .. | 4 lbs. |
| Water .. .. .. | 50 gallons.‡ |

Dissolve the 4 lbs. of copper sulphate in a wooden tub or bucket—*iron or tin vessels must not be used.* The easiest way to do this is to suspend the material, wrapped up in a piece of coarse sacking, in a few gallons of cold water, from a stick placed across the top of the tub, or wooden bucket. If this is done over night, the copper sulphate will be found to be dissolved in the water by the morning. (If hot water is used, the copper sulphate can be placed at the bottom of the tub or bucket, and if stirred occasionally will be dissolved in a few minutes). Then add water to make twenty-five gallons. Now take the four pounds of quick-lime, and put it in a tin pail. Add a few pints of water until all the lime is slaked, taking care to add only a little water at first; in this way a thick creamy paste is obtained. Add water to make twenty-five gallons. We have now twenty-five gallons of copper sulphate solution, and twenty-five gallons of " milk of lime." When the two substances are thus diluted with water, they can be mixed together by pouring one into the other, or a bucketful of each can be poured simultaneously or alternately into a third tub,—a wooden bucket being used for the copper sulphate solution. The " milk of lime " must be well strained, and it is advisable to strain again the Bordeaux mixture before spraying. In this way we obtain fifty gallons of Bordeaux mixture of the best quality.

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* Most of the first part of this article appeared in the *Journal of the Board of Agriculture* for January, 1910.

† In purchasing copper sulphate an article of 98 per cent. purity should be demanded ; substances described as " agricultural bluestone," or " agricultural sulphate of copper," must be avoided, as these are usually adulterated with iron sulphate. In the *Journal* of the Board of Agriculture for September last a number of cases are recorded of the sale in this country of adulterated copper sulphate ; it is clear, therefore, that it is important for growers to insist on an article of 98 per cent. purity.

‡ The strength of Bordeaux mixture at present most widely recommended in the United States is 9½ lbs. of copper sulphate and 9½ lbs. of quicklime to every 100 gallons (Imperial) of water. This strength is expressed in America by the formula 8·8·100, since (as Mr. Pickering has lately pointed out) the relative value of the American and Imperial gallon is different,—the former weighing 8.345 lbs. and the latter 10 lbs. As, however, in this country excellent results have followed the use of Bordeaux mixture made of the strength 8·8·100 (Imperial gallons), and as further, some " scorching " is liable to occur on certain varieties of apples with a mixture of this strength, it would seem advisable for the present for the English grower to continue to use this as his " standard " mixture.

Two points are of primary importance in making Bordeaux mixture. The first is that *quick lime*, in lumps (that is to say, as freshly burnt as possible), is used. Powdered *air-slaked* lime,—such as is often found in builders' yards, will not make Bordeaux mixture. The second point to observe is that the two constituents, *viz.*, copper sulphate and lime, are diluted with water as much as possible (consistent with the formula) *before being mixed together.** If concentrated solutions of copper sulphate and lime are mixed together, and water then added to make up the fifty gallons, the resulting Bordeaux mixture will be of very inferior quality.

Bordeaux mixture is fully efficacious only when freshly made, and will not keep. If more than a day old it requires to be very thoroughly and constantly stirred while being used, and the use of *only freshly-made* Bordeaux mixture is far more economical in the long run, and is here strongly recommended.

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* The method of mixing described above is that recommended by all scientific authorities in the United States and in our colonies. Bordeaux mixture prepared by growers in accordance with these instructions has long proved in these countries,—and more recently in England—to be of the greatest value, under practical conditions in the orchard or plantation, in keeping off fungus pests from cultivated plants. According, however, to the recent investigations of Mr. Pickering, a slightly superior method of mixing the two constituents is " to take the lime in as weak a condition as possible, and, consequently, the copper sulphate in as strong a condition as possible, and to add the copper sulphate to the lime. The ' milk of lime,' after being diluted with the bulk of the water, and stirred up several times during about half an hour, should be left for the grosser particles to settle before the copper sulphate is added to it, and after the addition of this, very little more stirring should be done."

If a considerable quantity of Bordeaux mixture is intended to be used, the making of *stock solutions* of copper sulphate and lime, which can be kept through the spraying season and used when wanted, saves both time and labour, and is free from all objection. The stock solutions are made as follows :—Take two 50-gallon barrels. In one dissolve 50 lbs. of copper sulphate in exactly 50 gallons of water. In the other slake 50 lbs. of lime by the gradual addition of a little water ; to the creamy paste thus obtained add water to make exactly 50 gallons of " milk of lime." These stock solutions will keep for months. Before the " milk of lime " is used, the contents of the barrel must be thoroughly stirred, as the slaked lime will have sunk to the bottom. (Care must be taken to stir the " milk of lime " *very thoroughly each time before measuring it out*, so as to get the slaked lime thoroughly in suspension. If this is done, there is no difficulty in obtaining the correct quantity of lime per gallon of fluid.) Each gallon which is taken out will be equivalent to, respectively, 1lb. of copper sulphate or 1 lb. of lime. The required amount of each stock solution is then diluted with water, according to the formula given above, before being mixed together. The " stock " copper sulphate solution must be measured out in a wooden pail.

If it is desired to economise space, the " stock solution " of copper sulphate may be kept at the strength of 2 lbs. of copper sulphate to each gallon of water, that is to say, 100 lbs. of copper sulphate are dissolved in 50 gallons of water. It is not well, however, to increase the strength of the " stock solution " of lime, since the slaked lime in " milk of lime " made at the rate of 2 lbs. of quicklime to a gallon of water settles so quickly that it cannot be measured out accurately.

The barrels containing the " stock solutions " must be kept under cover, *i.e.*, protected from sun and rain. If stood in a shed, and covered with fairly close fitting lids—made by nailing sacking round the edge of a wooden lid (see Plate 1)—such " stock solutions " keep perfectly satisfactorily throughout the spraying season. Two 50-gallon barrels hold sufficient for the making of 625 gallons of Bordeaux mixture ; while if the " stock solution " of copper sulphate is increased in strength to 100 lbs. to the 50 gallons of water, and another 50-gallon barrel of " stock solution " of " milk of lime " is added, these three barrels will supply enough to make 1,250 gallons of Bordeaux mixture. By storing such " stock solutions " made just before the summer spraying season commences, the grower has the means of obtaining in a few minutes at any time a large supply of Bordeaux mixture of the best quality.

The making of Bordeaux mixture on a large scale from " stock solutions" is greatly facilitated if some simple "plant" is erected, such as is shown in Plate 2. The erection consists of two elevated platforms. The higher platform is carried on four 9 ft. 6 in. posts, 5 in. by 4 in., sunk 2 ft. 6 in. in the ground, and well rammed. Joists, 5 in. by 4 in., connect the heads of the posts, into which they are halved. An intermediate joist is halved into the middle of two opposite joists. The upper platform is 5 ft. square, and consists of 6 in. by 1 in. boarding in the rough, laid to the edges. The lower platform, which is 6 ft. 6 in. square, is similarly constructed, and is carried on sleepers, 6 ft. long and 10 in. by 5 in., set vertically and sunk 2 ft. 6 in. in the ground and well rammed. The two structures are bolted together at the two back posts and where the front post of the higher platform touches the joist of the lower platform.

On the higher platform are two 50-gallon " dilution barrels," marked inside at the 50-gallon level, and fitted with taps. If possible, water should be laid on to this higher platform (note end of hose in Plate 2). On the lower platform stands a vat (fitted with a tap), capable of containing 100-gallons. A short length of hose (" canvas hose " is convenient to use) is fitted to the taps of the " dilution barrels " and of the 100-gallon vat. The process of making 100 gallons of Bordeaux mixture is as follows:—Eight gallons of the " stock solution " of " milk of lime," and the same amount of copper sulphate " stock solution " (or four gallons only, if this is of the strength of 2 lbs. of copper sulphate to the gallon of water) are carried up to the upper platform, and poured separately into the two " dilution barrels," which are then filled with water up to the 50 gallon mark. The fifty gallons of " milk of lime " thus obtained in one of the barrels are stirred vigorously for a couple of minutes. A strainer is now placed over the vat, in such a position as to allow the hose from the taps of the " dilution barrels " to project into it. The taps of the " dilution barrels " are now turned on, and—*the contents of the barrel containing the lime being* *stirred continuously*—the two 50-gallon barrels empty themselves through the strainer into the vat, filling it with 100 gallons of Bordeaux mixture (see Plate 2). The whole process can be easily controlled by *one man* standing on the higher platform, since with his stirring pole he can reach the taps, and so regulate the flow if necessary, and also stir and clean the strainer should this become clogged.* The Bordeaux mixture is immediately ready for use, and can be run off from the tap of the vat into the spraying machine on the ground. Thus all the labour and waste of time in handling the mixture are saved ; and, given the stock solutions, and some such " plant " as is shown here, 100 gallons of Bordeaux mixture can be prepared in a few minutes at any time during the spraying season. It is of the greatest importance for a fruit-grower to have the means of obtaining the proper "wash" directly the right stage of vegetation and suitable weather conditions arrive ; spraying *at the right time* is just as important as spraying *with the right " wash."*

Good straining of Bordeaux mixture is essential for success in spraying, since as pointed out below it is absolutely necessary to use a nozzle with a very fine opening. It is best to strain the mixture twice in the following manner. First, a strainer with meshes of medium fineness should be placed over the vat (see Plate 2). Then a second straining must be given as the Bordeaux mixture flows into the spraying machine. Here the best strainer is one with copper gauze with very fine meshes—thirty-five to forty holes to the linear inch. Such a strainer, made with a wooden bottom and sides of copper gauze, is fitted to spraying machines of the type shown in Plate 17. A simple and very useful type of strainer (suitable for " barrel " spraying machines and for general straining) as recommended by the United States Department of Agriculture,† is made as follows. It is in the form of a wooden box about a foot square (see Fig. 1, next page), the bottom of which is formed of hard wood,

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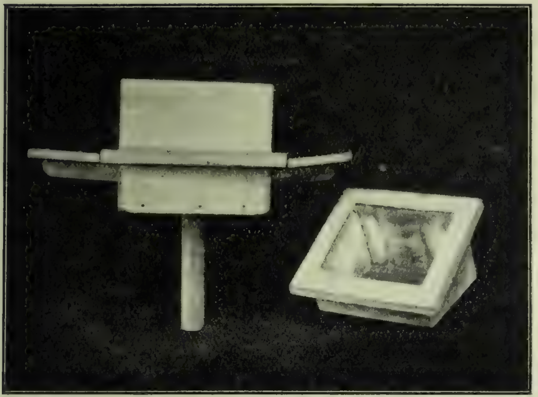
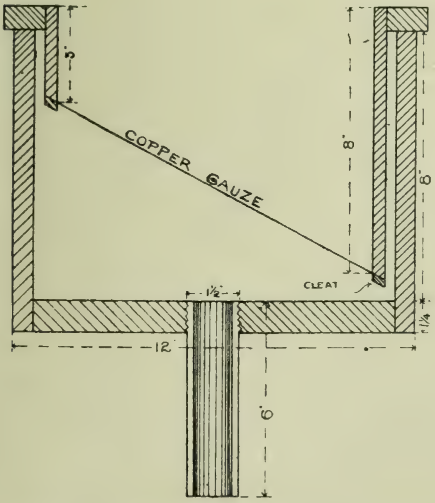
* In the actual " plant " shown in Plate 2, the top platform is higher than it need be to allow of the contents of the " dilution barrels " running into the vat. This extra height was fixed upon in order to allow, at any time, of a 50-gallon barrel being placed on the lower platform, when lesser quantities of any mixture made for experimental purposes can be run into it from smaller " dilution barrels " placed on the upper platform.

† Farmers' Bulletin, No. 243.

Fig. 1.



Strainer, showing the inner box (fitted with inclined bottom of copper gauze) which can be taken out for cleaning purposes. A cross section is shown below.



Cross section of a simple and useful type of strainer for use with Bordeaux mixture.

with a hole bored through it, into which a piece of gas pipe 1½ in. or 2 in. in diameter, and from 6 in. to 9 in. long, is fitted. The box is of course open at the top. Fitting just inside this box is a second and lighter box, also open at the top, and having an overhanging strip nailed round the top which supports it. The bottom of this inner box should be made so as to slope at an angle of about 30°, and should be made of fine copper gauze. The slanting bottom makes it harder to clog, and the inner box, being removable, can be inverted and washed in a tub of water (see Fig. 1). Bordeaux mixture, if properly strained, will pass easily through nozzles which throw the finest "misty" spray; while if not properly strained, frequent clogging of the nozzle will result. I have on several occasions sprayed for a whole day using the nozzle shown in Plate 10, where all the fluid has to pass through the minute hole in the circular disc (shown in Plate 10, Fig. 5) and, owing to the Bordeaux mixture used having been properly strained, have not had to stop once for any blocking of the nozzle.

If the lime used is freshly burnt (and it must never be forgotten that *air-slaked lime is useless for making Bordeaux mixture*), and carefully weighed out, there is no need to test the mixture before using it. When using "stock solutions" it is a good plan to apply a test at the first mixing. A rough test consists in immersing a clean wire, or French, nail, in the Bordeaux mixture for one minute; if safe to use, the mixture does not affect the nail; while if unsafe, a copper-plated appearance is given to it. A more delicate and quite simple test is as follows:—Procure from a chemist a small quantity of a 10 per cent. solution of ferrocyanide of potassium (which is a poison) and pour a little of this into a white saucer; then drop a few drops of the Bordeaux mixture into the ferrocyanide of potassium; if the mixture is safe to use no change of colour occurs, while a cloudy reddish-brown discolouration (very easy to see) occurs immediately if the mixture is unsafe to use. An unsafe mixture can be made safe to use by adding more milk-of-lime until it passes the above test.

In spraying fruit-trees (and also potatoes) there is no need whatever to add anything to Bordeaux mixture with the object of making it adhere better; soap is quite unnecessary and should never be used; treacle is useless. The nature of the precipitate which constitutes Bordeaux mixture causes it, when applied in a "misty" spray (see below), to adhere most intimately to the part sprayed.

Ready-made "Bordeaux mixture" is at present put on the market in powder form, and as a paste. The best results, however, in my experience, are only obtained when *Bordeaux mixture is home-made and freshly-mixed.* As regards the numerous proprietary "Bordeaux mixtures" put up *in powder form,** the fruit-grower must be warned against using these. Such preparations are made by mixing lime and copper sulphate in concentrated form, and then drying and grinding the product. As Mr. S. U. Pickering, F.R.S., has lately pointed out†: "Bordeaux mixture made by mixing these proprietary powders with water, settles at least ten times more rapidly than the freshly prepared mixture; consequently it is a very inefficient spraying material. There is a general consensus of opinion that in practical spraying, dried Bordeaux is really less efficient than the ordinary mixture." As long ago as 1900, Mr. R. J. Moss pointed out‡ how thoroughly inferior such ready-made "Bordeaux mixtures" are to the home-made, freshly-mixed article. One of the best known of these mixtures sold in powder form was tested in two ways. In the first experiment, the powder after being mixed with water according to the directions, was thoroughly shaken up in a glass cylinder, and then allowed to stand for five minutes. It was found that the suspended matter (containing all the copper) had almost completely disappeared (through subsidence) from the upper half of the liquid in so short a time as five minutes—*the percentage of copper in the upper half of the cylinder being only* 1.6. Another similar cylinder was filled with home-made Bordeaux mixture, and exactly the same treatment given to it, but here the tendency of the suspended matter, *i.e.*, all the copper, to subside was very different,—*the percentage of copper in the upper half of the cylinder after five minutes' subsidence being* 48.4. In the second experiment, the adhesive properties of home-made Bordeaux mixture were compared with those of the mixture made from the proprietary powder mentioned above. Investigations showed that, in the case of leaves sprayed with home-made Bordeaux mixture, the first shower of rain removed only 2.92 per cent. of the copper, and the second 3.65 per cent. of the copper, making a total washed off, of 6.57 per cent. of the copper. In the case of leaves sprayed with "Bordeaux mixture" made from the proprietary powder, *the first shower removed* 46.60 *per cent. of the copper, the second shower* 5.97 *per cent. of the copper, making a total washed off of* 52.57 *per cent. of the copper.*

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* *e.g.*, Strawsonite, etc.

† *Journ. Agric. Science,* III., 170 (1909).

‡ *Econ. Proc. Royal Dublin Soc.*, vol. I., part III., p. 109.

The Irish Board of Agriculture have carried on investigations for several years past in the spraying of potatoes with Bordeaux mixture, both home-made and made from spraying powders, and now strongly urge the farmer to prepare his own mixture.

It is clear that, on account of the marked tendency of the suspended matter to settle, and of the very low adhesive powers, all "Bordeaux mixtures" put up in powdered form should be avoided.

Ready-prepared Bordeaux mixture *in paste form* stands in quite a different category to the above-mentioned Bordeaux "powders." Through the recent chemical discoveries of Mr. S. U. Pickering, F.R.S., Bordeaux mixture is now able to be prepared by a new process and put on the market as a concentrated paste.* From the chemical standpoint, certain advantages (which cannot be discussed here) are claimed for the Bordeaux mixture made from this paste over that made by mixing equal quantities of copper sulphate and lime, as described above. Of what value these improvements from the chemical point of view will prove in practical spraying against fungus pests has yet to be ascertained, for there is probably a biological side to the question of the action of fungicides. For the reason given below I consider that the practical fruit-grower should continue to make his Bordeaux mixture with equal parts of copper sulphate and lime, *i.e.*, with a considerable excess of lime. So far as I have seen, if Bordeaux mixture is made (like that made from the Woburn Bordeaux Paste) *with practically no excess of lime*,† it either does not adhere so well to the parts sprayed, or more quickly washes off under the action of rain or dew, and consequently does not protect the plant for long from attacks of fungus pests. The season before last I compared the adhesive power of Bordeaux mixture made with milk-of-lime, *i.e.*, a mixture containing an excess of lime, with that of the mixture made with lime water, *i.e.*, containing no excess of lime. The two mixtures were tested in potato spraying on a fairly large scale. It was found that the latter mixture was washed off comparatively soon by the rain, and in consequence of this the " blight " (*Phytophthora infestans*) was not kept in check to anything like the same extent as where the haulm had been sprayed with the Bordeaux mixture made with milk-of-lime. Experiments were made last season with Bordeaux mixture made from the Woburn paste, both on apple trees and on potato haulm. In both cases all visible traces of the spray had disappeared several weeks before the spray from Bordeaux mixture made with excess of lime had become washed off. In the case of apple foliage, the " scab " fungus began to grow on the leaves, showing that there was a complete absence there of any fungicide. The same experience has been reported to me by a fruit-grower in East Kent, who for several seasons past has been successful in keeping a large acreage of apples practically free from " scab " by spraying with home-made Bordeaux mixture, although previously this pest had been very prevalent. This grower writes as follows : " I experimented with the Bordeaux paste and used it in exactly the same way as that which I made myself and found it practically worthless. Those trees which were sprayed with it were covered with apple scab, while those sprayed with the home-made mixture were kept practically free." On the other hand a fruit-grower in Sussex (on whom reliance can be placed) tells me that the use this season of Bordeaux mixture made from the Woburn Bordeaux Paste kept his trees healthy, although last year they suffered severely from " scab." Mr. Pickering (Eleventh Report, p. 178) says : " Reports received have led to the conclusion that the paste has been about as efficient [during the season 1909] as ordinary Bordeaux mixture."

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* The Woburn Bordeaux Paste, sold by W. Voss & Co., Glengall Road, Millwall, London, E.

† Bordeaux mixture containing no excess of lime can be easily made by using just enough lime (in the form of "lime water") to precipitate all the copper. (See Pickering, in Woburn Exper. Fruit Farm, Eighth Report, p. 9 (1908).

From my own experience I should advise the commercial fruit-grower at present—until more experiments have been made—to continue to make the bulk of his own Bordeaux mixture himself, while using a small quantity of the Woburn Bordeaux Paste experimentally.

### *II. The application of Bordeaux mixture.*

The best type of spraying machine for spraying with Bordeaux mixture depends to a large extent on such circumstances as the height of the trees, and whether these are grown in a plantation or in an orchard. But the chief point that requires to be emphasised is that the *nature of the spray* is the essential factor for success in spraying with Bordeaux mixture. The spray *must* be very fine and " misty " or smoke-like ; a hanging mist or " fog " must be produced which drifts over and through the tree and deposits on the surface of the leaves excessively minute drops which, when dry, give the parts of the tree which have been sprayed the appearance of being almost uniformly covered over with a very thin bluish film or dust. Such a deposit of Bordeaux mixture is so intimately attached to the surface of the leaf or fruit that *it does not readily wash off.* Last season, notwithstanding the frequent rains, I saw apple trees which had been properly sprayed with Bordeaux mixture still showing a bluish film over the leaves (and thus completely protected from the " scab " fungus) *nine weeks after the application.*

In order to obtain the right kind of spray, attention must be paid to two points : (1) a special type of nozzle must be used, and (2) sufficient pressure must be maintained at the nozzle. If these two requirements are not fulfilled, the full benefit from spraying with Bordeaux mixture cannot be obtained.

As regards the nozzle, the fact must be emphasised that a special type is required, which may be called the " Bordeaux nozzle." There is at the present time a very considerable amount of spraying with Bordeaux mixture being done in this country with unsuitable nozzles. This results not only in a waste of labour and material, but may cause actual harm,—sometimes to the trees by " drenching " those varieties which should be only lightly sprayed (see below, p. 255), and sometimes (in the case of orchards) by causing so much dripping from the trees and actual spraying of the grass around, that poisoning of sheep which may be allowed to feed on the grass in the orchard may result. It seems probable that actual cases of the death of sheep poisoned by feeding on grass around trees improperly sprayed with Bordeaux mixture occurred in Kent last season.

The *wrong* kind of spray for use with Bordeaux mixture is shown in Plate 3; here, although a small quantity of "misty, or smoke-like, spray can be seen hanging in the air, the greater amount of the spray produced is more or less jet-like, as shown by the lines of large drops which should be absent. Most kinds of nozzles used for hop-washing throw a spray of this nature, and at the present time much wasteful or even dangerous spraying is being done in this country with this type of nozzle. The right kind of spray is shown in Plate 4; here the greater part of the fluid is broken up at once as it leaves the nozzle into a very fine, "misty" or smoke-like spray.*

It follows that because the spray of Bordeaux mixture must be "misty," and not jet-like, *it must be carried close to the parts to be sprayed.* In the case of tall trees this necessitates the use of long bamboo "extension rods." The fact cannot be insisted upon too much that tall trees cannot be sprayed with Bordeaux mixture by means of a jet-like spray sent up from the ground; to secure a fine "misty" spray which shall drift over and through the trees and deposit itself uniformly over the leaves, a "Bordeaux nozzle" at the end of a rod of sufficient length must be used.

The best nozzles, in my experience, for putting on Bordeaux mixture, are the "Vermorel" and its modifications (of French, English and American make) (see Plates 6, 7, 8); the "Mistry" and "Mistry Junior" (see Plates 9, 10, 11, 12) of American make; and the "Spramotor" nozzle of Canadian make (see Plate 13). All these nozzles are now obtainable, for a small sum, in this country.†

It is necessary to warn growers against some nozzles now being put on the market. Some of these nozzles, *e.g.*, the "Enots" nozzle (Plate 14), are of the "Seneca" type (the best nozzle for lime-washes), and although advertised as "Bordeaux nozzles" are quite unsuitable for use with Bordeaux mixture.

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* Arsenate of lead) which protects the leaves of fruit-trees from all leaf-eating caterpillars) can be mixed with Bordeaux mixture with perfect safety; this combined insecticide and fungicide should be applied in a smoke-like spray, as described here.

† The "Vermorel" nozzle can be obtained from C. Clarke and Co., 16A, Bevis Marks, St. Mary Axe, London, E.C., and at agents through the country; the "Improved Vermorel" from Drake and Fletcher, Maidstone; the "Mistry," "Mistry Junior," and "Improved Vermorel" from Duke and Ockenden, 126, Southwark Street, London, S.E.; and the "Spramotor" from F. Greenhous, Pershore, Worcestershire.

To consider now spraying machines ; the three most important qualifications for the spraying machine to possess are as follows: (1) the machine and its chief working parts must be made of material which the sprays used will not affect chemically ; (2) the pump must be powerful enough to *maintain* a pressure sufficient for the particular nozzle used ; (3) the build of the machine must be suitable for use in the particular plantation or orchard to be sprayed. With regard to the first point, if machines with galvanised iron tanks are used when spraying with Bordeaux mixture, they must be carefully washed out after use, since this mixture after it has stood for a time will affect this substance. A narrow built-up tank of wood, or a barrel on wheels (where its width is not objectionable) is preferable, not only for the above reasons, but because a wooden (or copper) receptacle becomes essential when any spraying is done with the winter-wash of copper sulphate solution. All the working parts of the pump should be of gun-metal or bronze. The machine must be fitted with an agitator. The build of the spraying machine is dealt with in the following remarks on the various types of spraying machines shown in Plates 15 to 22.

I have seen excellent spraying done on a commercial scale in plantations of bush apples (with currants or gooseberries planted between) by a gang of men using "Eclair" knapsack sprayers. Some experienced fruit-growers consider that the work can be done quickly and cheaply by this method, while there is no danger of damage being done to the low branches of the trees or to the inter-planted bushes, such as may happen when a spraying machine on wheels is dragged through a plantation. An East Kent fruit-grower who has sprayed a considerable acreage of apples with Bordeaux mixture each season for several years past informs me that using knapsack sprayers, the cost of spraying one acre of trees, about ten or twelve years old, and planted ten feet apart, is approximately 5s. for the material, and 10s. to 12s. for the labour. While knapsack sprayers, when kept in good order, and when on the backs of men who pump sufficiently hard to maintain the necessary pressure, are satisfactory, there is always the danger of these two requirements not being fulfilled, when an inferior spray is produced and the full advantages of the use of Bordeaux mixture will not be obtained. For spraying young trees in newly-planted plantations a knapsack sprayer is excellent.

A very useful type of machine is shown in Plate 15. The pump is of Canadian make, and costs £3 15s.; it can be fitted to a 30-gallon barrel provided with a "stretcher" or hand-barrow arrangement—as shown in the illustration—at an additional cost of £1 2s. 6d. The two iron lances are fitted with a cluster of nozzles. This "Spramotor" nozzle gives an excellent "misty" spray, and is best used in a cluster of three (see Plate 13). This machine can be carried by two men in closely planted plantations without damaging the trees or bushes. It is used to a considerable extent in the Evesham and Pershore districts, and has lately been introduced into Kent. The pump is strong, and is in extensive use in Canada. One of these pumps has been used for the past two seasons by a fruit- and hop-grower in Kent for spraying both fruit-trees and hops. In this case the machine, when used with a horse in the hop-garden, is adapted by attaching temporarily an axle with two wheels to the front legs, and a whippletree to the front handles of the "stretcher." The cost of this spraying outfit (exclusive of wheels and whippletree), as shown in Plate 16, is £8 10s.

A very convenient type of machine, with either wooden or galvanised iron tank, of from twenty to forty gallons capacity, is shown in Plates 17, 18. Machines of this type, very strongly made, are now constructed by several firms in Kent.* The machines shown in the illustrations contain thirty gallons, and are built very narrow (measuring only 22 in. wide over all) for use in closely planted plantations. An air-chamber is supplied of sufficient size to secure the maintenance of the necessary pressure between the strokes of the pump. With a good "Bordeaux nozzle"—such as the "Vermorel" or the "Improved Vermorel" (of English make) which are sent out with some of these machines—there is no difficulty in keeping up the pressure and obtaining a continuous fine "misty" spray without undue exertion being required of the man at the pump. More uniformly good spraying can be secured with such a machine than with a knapsack sprayer. The cost, including two lengths of hose, brass or bamboo extension rods, and nozzles is from £10 to £12.

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* W. Weeks and Son, Maidstone; Drake and Fletcher, Maidstone; H. S. Tett and Co., Faversham.

For orchards, or for places where the trees can be reached from a path, the type of machine* shown in Plate 19 is excellent. It is both strong and cheap. The pump, of American make, costs £3 2s. 6d.; the barrel and carriage on wheels (as shown in the illustration) costs £3 5s. extra. Fitted with "Mistry" or "Mistry Junior" nozzles, it applies Bordeaux mixture in a uniformly fine "misty" spray.

A useful spraying outfit for large trees in orchards is shown in Plate 20. The pump is double-acting and very strong; there is a large air-chamber, provided with a pressure-gauge. A pressure of seventy or eighty pounds can be easily maintained by one man pumping. Mounted on a trolley on wheels, with a barrel of Bordeaux mixture by its side, and either pulled by hand or harnessed to a horse, it constitutes a very efficient outfit. By means of long extension rods, worked by men standing either on the ground or in a van or waggon, orchards of tall cherry trees affected with "Cherry Leaf Scorch" or "Brown Rot," or of tall apple or pear trees affected with "Scab," can be easily and thoroughly sprayed. The cost of the pump alone is £7.*

Plate 21 shows another machine† for use in orchards. The barrel holds sixty gallons; the double-acting pump is worked by two men. The pump costs about £11; the whole outfit (as shown in the illustration) with two 30 ft. lengths leading into four 15 ft. lengths of hose, with four extension rods, and sets of nozzles, costs about £24.

Another method is to have a powerful pump (mounted on a carriage on wheels) placed along the headland of a plantation or among the trees in an orchard, and to carry hose from this to the trees. The suction pipe of the pump draws the Bordeaux mixture from a trough or tub, or from a water-cart, placed by its side. I have seen a large acreage of apple orchards sprayed very easily

* Sold by Duke and Ockenden, 126, Southwark Street, London, E.C.'

† Sold by W. Weeks and Son, Maidstone. Similar type of machine sold by Weald of Kent Engineering Co., Horsmonden.

and efficiently in this manner. A suitable type of pump is shown in Plate 22; it is a double-barrel lift and force pump, worked by two men, who are guided in keeping up the necessary pressure by reading from the pressure gauge. The cost of such a pump* is from £14 to £20. A main delivery pipe is laid from the pump through a part of the plantation or orchard, and cross-piece connections with delivery pipes are laid to right and left at regular distances, so that a complete block or section of the trees is sprayed before moving the pump to the next point. Three hundred yards or more of hose can be laid down, and six or eight men can spray from it. With such a plant, however, it is doubtful if a pump worked by hand-power is in the long run so economical as a power-driven machine. There are now various types of oil-, petrol-, or steam-driven engines, specially constructed for spraying work, and various methods of laying down pipes or hose; these, however, cannot be treated of in this article.†

A very useful implement in the work of spraying is a hand-cart on two wheels. A strong and cheap type,‡ costing £2 7s. 6d., is shown in Plate 23. The arrangement here is such that any barrel can be picked up and held in place by an adjustable chain that passes round the barrel. In this way a pump attached to a barrel can be mounted, as shown in Plate 19; it is also very useful for handling extra barrels of spray mixtures.

III.—"*Bordeaux injury.*"

Although the use of Bordeaux mixture as a regular spray for apple trees to keep off fungus diseases has only lately been brought to the notice of fruit-growers in this country, it must be remembered that in other countries (where the interests of the fruit-growing industry are looked after by an efficient Board of Agriculture, or separate State Horticultural Department, and not neglected by the Government, as in this country) this wash has been in general use by the commercial fruit-grower for a considerable number of years. As Mr. Pickering has recently pointed out* :—" Bordeaux mixture has practically superseded every other fungicide for general use, and two or three sprayings with it have become part of the annual routine of the fruit-grower in most countries except our own, whilst in viticulture its use is quite indispensable and potato growers are applying it more and more every year." It is not surprising, therefore, that there exists already in other countries a considerable literature on the subject of the effect of spraying with Bordeaux mixture in different seasons. On looking through this literature we find that in all the countries where Bordeaux mixture has been in general use for a number of years for spraying apples on a commercial scale, reports have been published from time to time recording the occurrence of a certain amount of injury resulting from spraying *in certain seasons*. Such injury has been termed variously " Bordeaux injury," " spray injury," " scald," " burning," " spray russeting," " cork russeting," and " yellow leaf," and has been reported from most of the apple-growing districts in North America, Europe, Australia, Tasmania, and New Zealand.

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* Sold by Drake and Fletcher, Maidstone; and a similar type by Weeks and Son, Maidstone.

† A collection of spraying machinery (including knapsack sprayers), as well as of the various types of nozzles, is kept at Wye College, and can be seen at any time by appointment.

‡ Sold by Duke and Ockenden, 126, Southwark Street, London, E.C.

In this country the same kind of injury may occasionally be observed, and the following notes are given in the hope that they may prove of some assistance to growers who, while wishing to use Bordeaux mixture as the only proved remedy against apple " scab " and other fungus diseases, are anxious to take all possible precautions to prevent the trees being injured by this spray.

The injury which I have noted as sometimes following the application of Bordeaux mixture on apple trees becomes evident sometimes on the leaves and sometimes on the fruit. With regard to the leaves, these may show (1) local injuries in the form of brown spots which soon drop out; when the portions affected fall out from the central part, a " shot-hole" appearance is given to the leaf, while if the portions affected fall from the edges of the leaf, a jagged or notched appearance is given to the leaf, at first sight suggestive of the action of caterpillars; (2) a " scorching " of the edges or tip of the leaf, or the formation of brown patches which do not fall out; (3) a yellowing or browning of the whole leaf, which subsequently falls. In my experience the "shot-hole" effect on the leaves is the form of injury which results when a too heavy spraying is given, *i.e.*, when leaves are coated over with a *thick*, instead of a very thin, layer of Bordeaux mixture. The injury denoted by the yellowing or browning, and subsequent fall, of the leaf may follow after careful spraying with a properly-prepared mixture, and seems to be dependent on unknown weather conditions. This form of injury occurs apparently *only on certain varieties of apples.*

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* *Journ. Agric. Science*, III., 170 (1909).

As regards the fruit, this may sometimes show injury in that the apple becomes rough and "russeted," due to the formation of dead corky cells at the places where the action of the spray has caused a rupturing of the epidermis ; in cases of severe injury, the apple cracks. Or the effect of the spray (on young apples from a quarter- to half-grown) may be to produce unnatural blotches of purplish colour on the sprayed portion. Both these kinds of injury are liable to appear only on certain varieties of apples. The "russeting" or "rusty" appearance is most marked in those cases—if indeed it is not confined to them—where the trees are sprayed about a week or two after the fruit is set. I am inclined to think that the safest time to spray those varieties whose fruit is liable to become "russeted" is immediately the bloom has fallen, or even in cases where the trees are flowering profusely, while a little of the bloom still remains on the tree. A later spraying is often necessary, especially with varieties (such as Ecklinville) which produce a considerable amount of fresh foliage during midsummer growth. If this fresh foliage is not sprayed, the "scab" fungus increases on the new (unsprayed) leaves, and spreads thence to the half- or three-quarter grown apples and without much affecting their growth in size ruins their appearance and keeping qualities by covering them with "black spots." *A light spraying*—just sufficient to protect the new leaves of the midsummer growth—at a time when the apples are about three-quarter grown seldom, if ever, produces that serious "russeting" which may occur when the whole tree has been sprayed at the time when the apples are about a quarter grown or smaller.

The actual causes which produce "Bordeaux injury" are still very obscure ; it seems clear, however, *that subsequent chemical changes in the Bordeaux mixture after it has been sprayed on the plant and there exposed to various weather conditions* (*especially wet weather*) *are largely concerned in causing the injury.* The matter is complicated by the fact, recently discovered by Mr. S. U. Pickering* that the chemical compounds formed in Bordeaux mixture vary considerably according to the exact proportions of copper sulphate and lime used, and also according to the method of mixing them. Without considering here the complicated chemical questions involved—which are still unsettled,—we may note the practical conclusions on the subject of this injury, and how it may best be avoided, which have been arrived at by horticultural authorities in the United States, after a long and careful investigation of the matter as it affects the commercial apple-grower in that country. The following notes are taken from Bulletin No. 287 of the New York Agricultural Experiment Station, written by Prof. U. P. Hedrick:—"There are many anomalies of occurrence brought about, for the most part, by weather conditions; as damage in some seasons, not in others; in some localities and not in others; some report dry seasons as favouring injury, others wet; some trees of a variety are injured more than others; the injury is sometimes most severe on the fruit and sometimes on the foliage; the fruit alone of some varieties is immune and of others, the foliage; the injury may appear in a few days or may not show for several weeks after spraying. Some varieties of apples are injured much less than others by Bordeaux mixture, and there is a wide range in this variation."

The practical suggestions given in this Bulletin to fruit-growers as to how to avoid the injury are as follows: (1) In spraying use less copper sulphate; give the 3-3-50 formula† for Bordeaux mixture a thorough trial. Spray in moderation; spray to cover the foliage and fruit with a thin film and yet not have the trees drip heavily. So far as possible the Bordeaux mixture should be used only in dry weather. Use equal amounts of lime and copper sulphate. (2) Some varieties of apples may be sprayed without much fear of injury. Others must be sprayed with great care. Distinguish between the varieties in spraying operations. (3) Many varieties of apples are nearly immune to attacks of the scab fungus. These need comparatively light applications of Bordeaux mixture in the average season. (4) Bordeaux mixture is the best fungicide known to the apple grower. Its use cannot be given up in fighting the apple "scab," even though it cause some injury; apple "scab" causes a far greater loss than "Bordeaux injury."

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* Woburn Experimental Fruit Farm, 8th Report, p. 7 (1908).

† Equivalent to $3\frac{3}{5}$ lbs. copper sulphate and $3\frac{3}{5}$ lbs. quicklime to 50 Imperial gallons (see note at foot of p. 240).

It remains now to be considered to what extent these conclusions apply to apple-growing in this country. In the first place it is quite certain that we find in this country also that certain varieties of apples are susceptible to Bordeaux injury while others are not, although it appears that possibly this susceptibility may vary in different localities. In the season of 1908 I observed a case in the Maidstone district where the fruit of certain varieties, which had been sprayed a few weeks after the fruit had set, showed injury in the form of abnormally coloured "blotches" on the skin of the apple,—these varieties were Tower of Glamis, Lucombe's Seedling, and Ecklinville. Trees of the three following varieties, sprayed at the same time, showed no injury,—Beauty of Bath, Wellington, Newton Wonder. Last season the grower sent me the following notes :—"The two sorts of apples which happened to be cropping with me were sprayed with Bordeaux mixture (made on the 4-4-50 formula) once before blossoming, and once afterwards at a time when the apples had formed. No damage was done to the leaf, but as happened in the previous season, the apples on Lucombe's Seedling and Tower of Glamis were rather badly damaged,—the fruit being small and very 'russeted.' I grew a large crop of Williams' Pears; here the leaves and the fruit were heavily sprayed with Bordeaux mixture—in fact we 'washed' the trees; no damage was done at all, and I have never grown previously such clean, good fruit." In another district (Paddock Wood) it was noticeable last season that rather late spraying, *i.e.*, after the apples were formed, resulted in a large proportion of the fruit on the three following varieties becoming "rusty" or "russeted,"—Cox's Orange (badly affected), Bismarck, Beauty of Bath; while the following four varieties, similarly sprayed, showed no injury,—Lord Derby, Warner's King, Souring, Ecklinville. With respect to the last four varieties, the trees had produced in previous seasons very "scabby" crops, but last season, as the result of spraying with Bordeaux mixture, they bore a practically clean crop, and the spraying did no damage to the fruit or foliage. Here, then, is a case, and there are no doubt scores of similar ones, where it would pay the grower to distinguish between different varieties of apples in spraying.

In another case last season, a particular variety stood out conspicuously as resistant to " injury." In this instance it is possible that some of the Bordeaux mixture used was made with partly air-slaked lime, and on this account the mixture may have been specially injurious. Two sprayings were given to a considerable acreage of trees, and resulted in serious damage being done to practically all the trees of Lord Derby (on which the fruit was severely " russeted," and the leaves yellowed) and of Cox's Orange (on which most of the leaves were so injured that they fell), while trees of Potts' Seedling, standing among the Lord Derby, and sprayed with them, were unharmed.

Secondly, it is a fact that among English apples some varieties are immune, or at least resistant, to " scab." Such varieties are Bramley's Seedling, Lane's Prince Albert, Grenadier, Queen, The Victorian, Golden Spire, and Stirling Castle. Then again there are a number of varieties such as Lord Derby, Beauty of Bath, Newton Wonder, Worcester Pearmain, Allington Pippin, which are by themselves but little liable to " scab," but become infested when the disease is rampant in their neighbourhood. When varieties of apples which are *specially susceptible to " scab "* as regards their foliage or young wood, such as Cox's Orange Pippin, King of the Pippins, Ecklinville, Lord Suffield, Wellington, Bismarck, Lord Grosvenor, Summer Pippin, are grown contiguous to those varieties which are partly resistant, the aim of the grower should be to keep the susceptible varieties clean by thorough and systematic spraying, treating with the *winter-wash* of copper sulphate solution those varieties *whose young wood becomes " scab "-infested** when the former varieties will as a rule not need spraying at all. In the case of Cox's Orange Pippin, which it is difficult to spray at all in summer without injuring, the aim must be to keep the surrounding varieties free from " scab " by spraying, and in this way avoid letting the scab invade the young wood of Cox's Orange Pippin, as it readily does if given an opportunity.

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* See Leaflet on Apple " Scab," which can be obtained on application to the Secretary.

It sometimes happens that a block of trees of Cox's Orange Pippin get badly infested with "scab" by the planting up of young diseased trees (for unfortunately it is by no means rare for young trees of this variety to be sent out from English nurseries with the young wood badly infested with "scab"); in such a case regular applications of the *winter wash* of copper sulphate solution will ultimately result in healthy wood being grown, when the chief source of the disease will be removed.

Thirdly, it seems certain that in any one season "Bordeaux injury" may occur *in some localities* and not in others. Some marked instances of this have occurred in Kent during the past season. For instance, "Bordeaux injury" occurred in the districts of Maidstone, Paddock Wood, Southfleet and Longfield, both "russeting" of the fruit and the yellowing and falling of the leaves being noticed as the result of spraying in several orchards or plantations in these districts. In other localities, in plantations where an equal amount of Bordeaux mixture—if not more—had been applied during the same season, no injury of any kind could be observed. For instance, on a fruit farm near Broadstairs all the trees, consisting of the following varieties, were very thoroughly sprayed* twice (once before flowering, and once or twice directly after flowering), with Bordeaux mixture made of the 4-4-50 strength,—Golden Noble†, Ecklinville, Cox's Orange Pippin, Worcester Pearmain, Domino, Tom Putt†, Blenheim Orange, Benoni†, Wellington, Jacques Lebel, Cox's Pomona†, Allington Pippin†, Charles Ross, Royal Snow†, Glory of England†, Warner's King†, Betty Geeson†. No injury at all on the leaves or fruit of any of these varieties could be observed, while the fungicidal action of Bordeaux mixture had kept all the trees practically free from "scab," the value of the mixture in this respect being most marked in the case of those varieties distinguished by a †, since these in the previous seasons had borne very "scabby" crops. Again, a grower from the district of Canterbury wrote last autumn of his experience as follows:—"I have no fault to find with the result of my spraying with Bordeaux mixture this season. Gladstone apples shed some of their leaves about a fortnight after the last spraying, but I am not at all certain if that was the result of the spraying ; and Beauty of Bath and Cox's Orange fruits were a trifle rough, but I think that was more to do with the weather than the spraying. Bismarcks were most certainly improved by the Bordeaux ; other varieties of apples I sprayed were Worcester Pearmain, Lady Sudeley, Cox's Pomona, Gascoigne's Scarlet, Lane's Prince Albert, Newton Wonder, King Pippin, Allington Pippin, and a few other varieties. All these showed no injury at all, and were all quite free from ' scab,' except in one small patch where they were not sprayed after the bloom had fallen, and there they showed ' scab.' I have come to the conclusion that Bordeaux mixture has done no injury to my apples this year, and that the most important times to spray are just before the flower buds open and about a week after the bloom has fallen."

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* The trees were so thoroughly sprayed that nine weeks after the application the leaves of many of the trees appeared bluish from the spray.

In connection with this important subject of injury following the application of properly-made Bordeaux mixture, *i.e.*, the occurence of true " Bordeaux injury," it is necessary to emphasise the fact that caution is required in its investigation. The presence of injury (even though it be indistinguishable from true " Bordeaux injury ") on sprayed trees must not be considered as evidence of the injurious action of the spray unless " control " trees which have been left unsprayed show no such injury. Further, there are many causes at work,—some of which are controllable, while others are not—which produce injuries often exactly similar to " Bordeaux injury." Such injuries are being constantly confused with " Bordeaux injury."

In the first place, unless care has been taken to use only *freshly burnt quicklime* (*in lumps*) in the making of Bordeaux mixture a scorching of the leaves will certainly follow. The use by fruit-growers of mixtures made with partly air-slaked lime is unfortunately of common occurrence ; *such mixtures undoubtedly cause serious injury to foliage and fruit.* Again, *leaves already attacked by fungi* will, when sprayed with Bordeaux mixture, show very pronounced injury. For instance, if leaves of an apple tree which are already covered with the " sooty " patches of the " scab " fungus (see this *Journal*, Vol. XV. (June, 1908) Plates II.—IV.) are sprayed with properly made Bordeaux mixture, *the portions of the leaf covered by the fungus will turn brown or blackish and soon* *die*, or if the whole leaf is infected by the spawn (*mycelium*) of this fungus, it will become discoloured and *will shrivel up.* It is important for the grower to remember that he must get the Bordeaux mixture on to the leaves as early as possible each season, that is, before the fungus has spread to these parts.

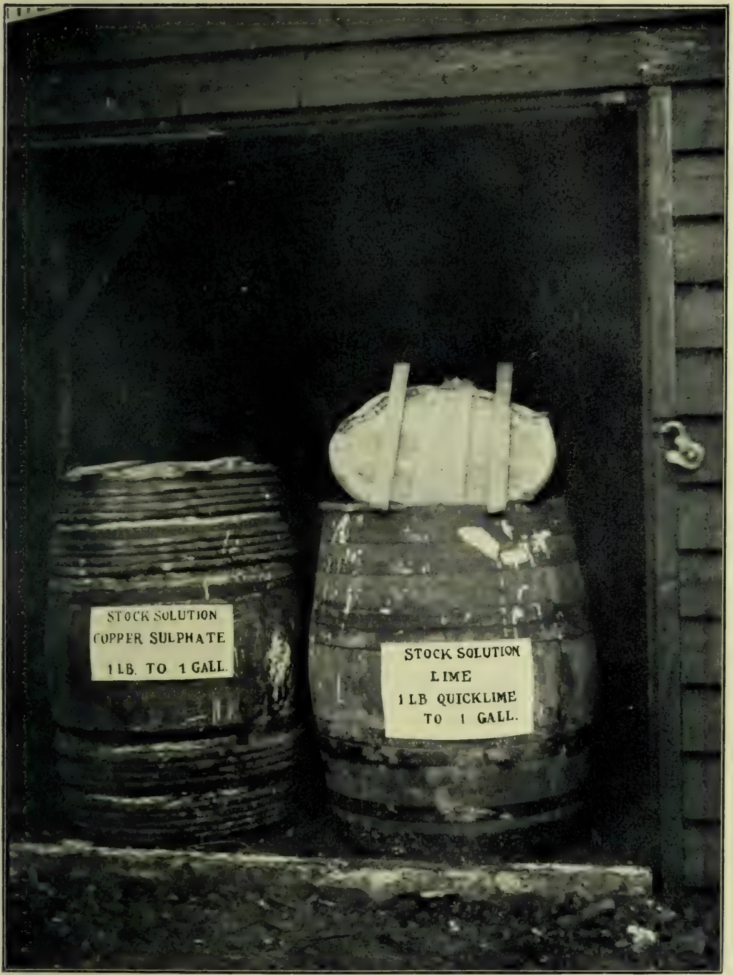
But the commonest form of injury confused with " Bordeaux injury " is that caused by unfavourable weather conditions. Exactly what these weather conditions are is unknown. During the seasons 1908 and 1909 I have had a considerable number of specimens of young apples (sent to me from districts in Kent, Surrey, Worcestershire and Herefordshire) which were split or deeply cracked and more or less russeted. These apples, which were about a quarter grown, were supposed by the growers in some cases to be affected by the " scab " fungus ; by other growers to be affected by " spray injury." Investigation showed that no fungus was present, and also that this injury occurred *on sprayed and unsprayed trees alike.* It seems that under certain unfavourable weather conditions—perhaps cold nights—soft-fleshed apples, such as Beauty of Bath, are liable to this injury. During the past season two forms of injury to apple leaves, due to unfavourable climatic conditions—possibly an excessive rainfall or, in some districts, low temperatures at night and cutting winds —have been much in evidence. The injury has consisted in (1) the whole leaf turning brownish and falling from the tree ; (2) the edges, or occasionally the tip of the leaf, turning brown and curling or shrivelling, giving the whole tree (or sometimes only a branch or two of it) the appearance of having been badly scorched by a dangerous spray, or—where the injury was very severe,—of having been injured by a fire lighted in its neighbourhood. In several instances this injury has been ascribed erroneously to the after-effect of Bordeaux mixture. In two cases where this kind of injury was very pronounced, investigation showed clearly that " weather conditions " alone were the cause. In the first of these cases the plantation concerned was at Wye College ; here the " scorched " appearance of many rows of apple trees was very noticeable last summer. Had the whole of such a plantation been sprayed with Bordeaux mixture, and no " controls " left, the conclusion would inevitably have been drawn by the practical man that the injury was due to the spraying. As it so happened, only 441 trees out of the 1,500 trees in this plantation had been sprayed. Consequently it was possible to compare sprayed with unsprayed trees. The facts were as follows :—The following eleven varieties were sprayed a few weeks after blossoming,—Wellington, Bismarck, Duchess' Favourite, Warner's King, Newton Wonder, Cox's Orange Pippin, Blenheim, Stirling Castle, Ecklinville, Cornish Gilliflower, Twenty Ounce. Some trees of Wellington and Cox's Orange Pippin were sprayed twice, and all the trees of Blenheim and Stirling Castle. By July 27th a large number of trees in the plantation showed a " scorched " appearance round the edges of the leaf, or extending over the greater part of the leaf,—in severe cases whole boughs looked as though their leaves had been scorched by fire. In a few instances a single bough, or one or two boughs, showing this scorched appearance, appeared on a tree, while the leaves on the remaining boughs were green and uninjured. Investigation showed that *this injury was quite as pronounced on the unsprayed trees as on the sprayed trees.* Some of the facts observed in connection with certain varieties are of interest. In one strip of the plantation a row of ninety-four trees of Wellington were sprayed ; some of the trees subsequently showed the " scorched " appearance of the leaves described above ; the same kind of injury, however, was much more marked on the two rows, on either side, of trees of Worcester Pearmain and Lane's Prince Albert, *although these had received no spray.* The injury was so severe on the Worcester Pearmains that the trees were weakened to such an extent that the apples never developed to full size, but dropped off. In a row of eighty-eight trees of Newton Wonder which were sprayed, no injury appeared except on the trees which crossed a plot of ground where a manurial experiment—under which the trees had been partially starved—had been carried on—here the leaves turned brown at the edges or ultimately died. This fact suggests that injuries due to climatic conditions are most liable to appear on trees that are not vigorous. Another variety which presented the " scorched " appearance to a marked degree, and *which had not been sprayed,* was Hoary Morning. The varieties which were sprayed and which showed no injury of any kind on the foliage were as follows :—Ecklinville, Warner's King, Blenheim, Stirling Castle, Cornish Gilliflower.

Another very interesting case occurred in a plantation at Teynham, Kent. Here at the beginning of August last year a large number of trees of the varieties Beauty of Bath, Cox's Orange, King of the Pippins, Charles Ross, Allington Pippin, and Peasgood's Nonsuch, showed exactly the same kind of injury as noted above in the Wye College plantation,—the leaves being brown and dead at the edges or tip, while in one variety, *viz.*, Duchess' Favourite, the trees had dropped most of the leaves and nearly all their crop. None of the trees in this plantation at Teynham had received any spray on the leaves. Taken altogether, the trees were well-grown and vigorous, had borne well in previous seasons, and not before shown this injury. One point was very noticeable,—in all the varieties where the " scorched " appearance occurred, the injury was the more pronounced the weaker the growth of the tree. This again suggests that the unfavourable weather conditions,—whatever they are—which appear to be the cause of this kind of injury, are withstood best by the most vigorous trees.

## Conclusions.

In view of the fact that it is practically impossible in this country to keep any considerable acreage of apples free from " scab " or " black spot " without spraying with Bordeaux mixture, and that while the use of this mixture is being followed by complete success in many districts, in others " Bordeaux injury " to a greater or less extent has followed the spraying, the fruit-grower should pay attention to the following details in spraying : (1) use a " Bordeaux nozzle," which throws a fine misty spray ; spray the trees lightly, and leave off before the trees begin to drip ; (2) distinguish between the different varieties of apples, giving those which are liable to show " Bordeaux injury " a *very light* spraying with Bordeaux mixture made of 3 lbs. copper sulphate, 3 lbs. quicklime (in lumps), 50 gallons water (mixed as described above) ; or spray such varieties experimentally with the lime-sulphur wash. (Fruit-growers must remember, however, that although some success has lately been obtained in the United States with this lime-sulphur wash as a fungicide for use on tender-leaved fruit trees, it is unquestionably inferior to Bordeaux mixture as a general fungicide) ; (3) concentrate attention in spraying on those varieties whose leaves get " sooty " with the " scab " fungus and whose young wood gets infested,—varieties resistant to " scab " do not as a rule require to be sprayed; (4) spray *directly* the blossom has fallen, and where necessary, again when the apples are about three-quarters grown ; (5) use *freshly-mixed home-made* Bordeaux mixture, prepared from the best freshly-burnt quicklime (in lumps).

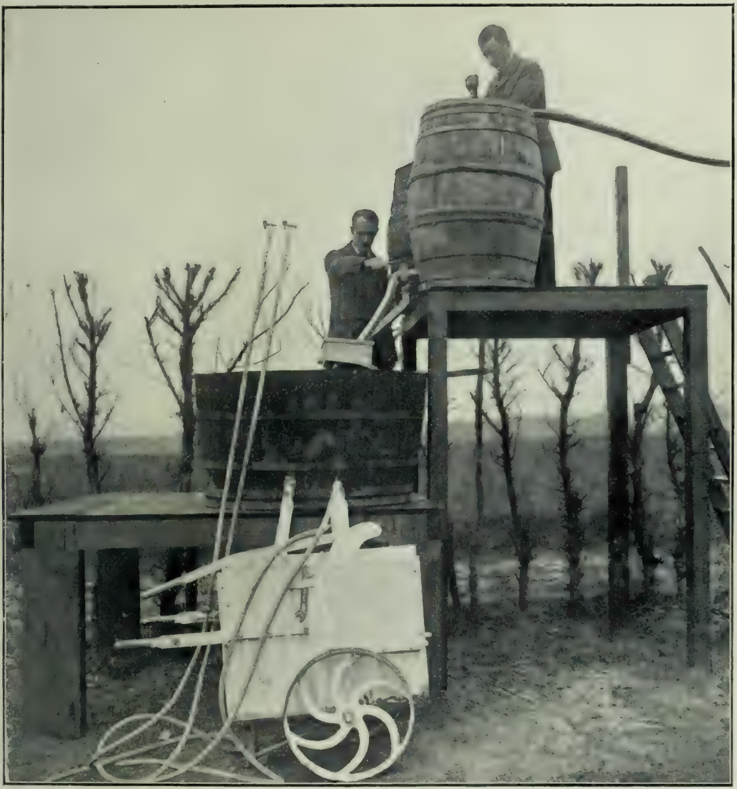
PLATE 1.



[*F. V. Darbishire, photo.*

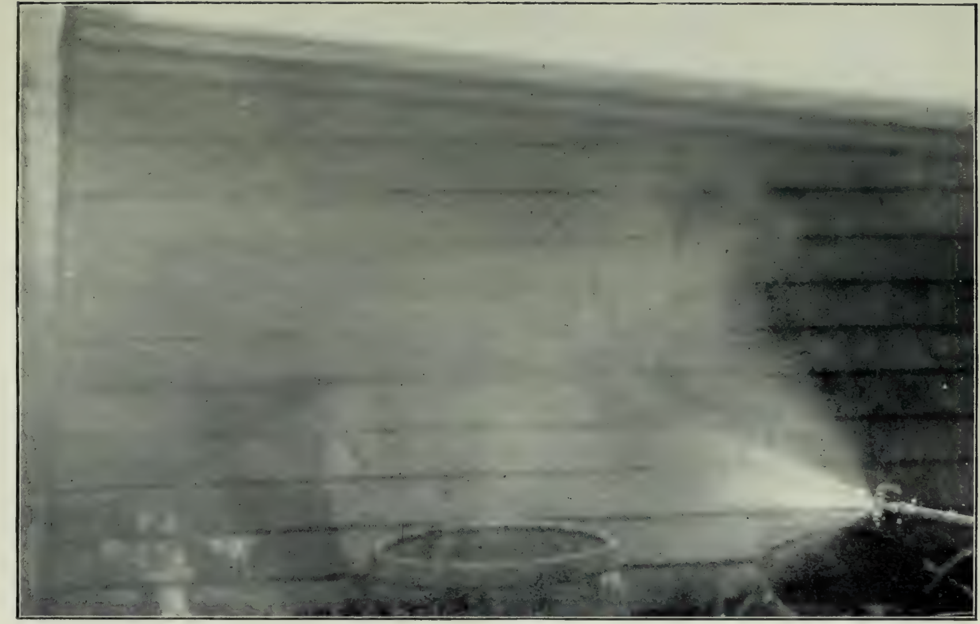
Two 50-gallon barrels containing "stock solutions" of copper sulphate and lime, sufficient to make 625 gallons of Bordeaux mixture. By the use of a "plant," such as is shown in Plate 2, 100 gallons of Bordeaux mixture, strained ready for use, can be made in a few minutes.

PLATE 2.



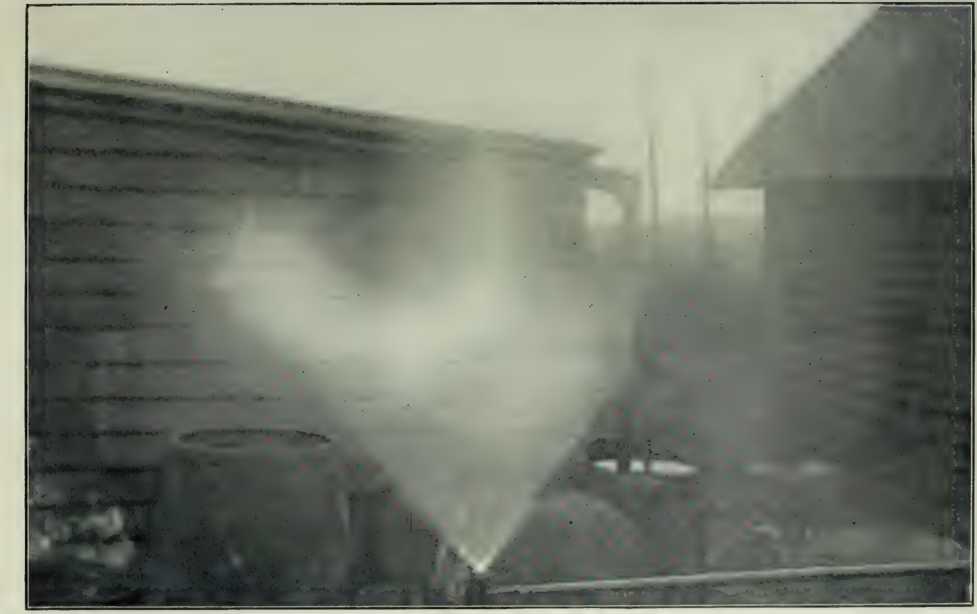
"Plant," consisting of two elevated platforms, for making Bordeaux mixture from "stock solutions." Fifty gallons each of copper sulphate solution and "milk-of-lime" are run together, from the "dilution barrels" on the upper platform, through a strainer into the vat on the lower platform. The Bordeaux mixture thus obtained is run through a fine strainer direct into the spraying machine.

PLATE 3.



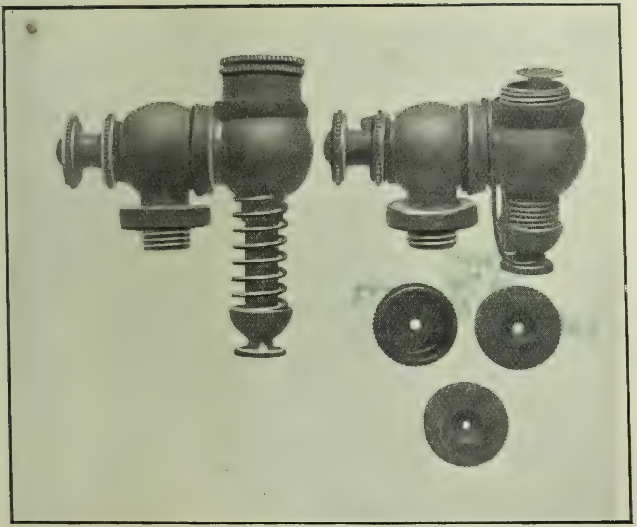
The *wrong* kind of spray for use with Bordeaux mixture; the greater part of the spray is jet-like and composed of large drops,—only a little "misty" or smoke-like spray being produced. The nozzle is the "Enots" (see Plate 14).

PLATE 4.



The *right* kind of spray for use with Bordeaux mixture; the greater part of the spray is broken up into a " mist " or " smoke " directly it leaves the nozzle,—large drops are almost absent. The nozzle is the " Mistry Junior " (see Plate 12).

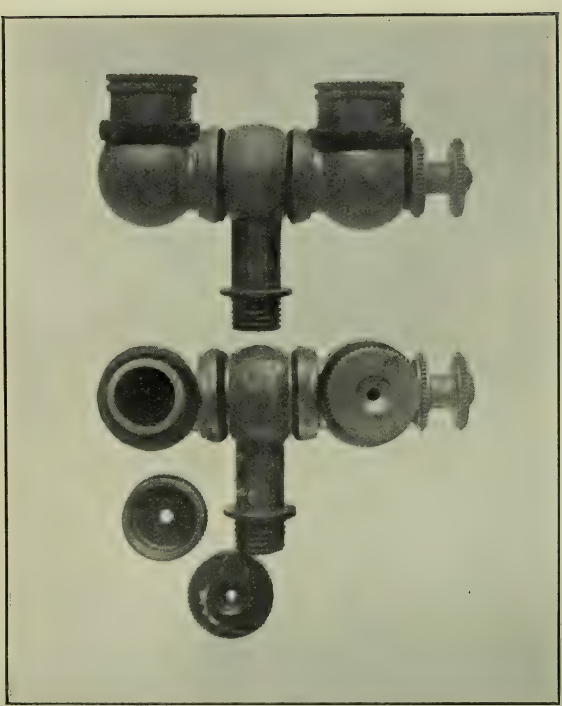
PLATE 5.



[*W. H. Hammond photo.*

"Vermorel" nozzle (French make), with disgorger (shown pushed up in example to right, where the cap is removed). The caps have small holes (bevelled at the edge from the outside) of three different sizes. The nozzle can be adjusted by the screw to spray in any direction.

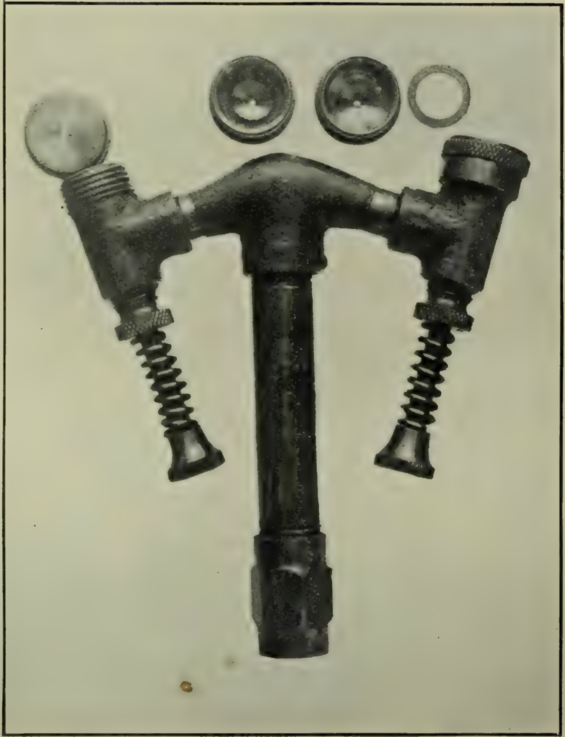
Plate 6.



[*W. H. Hammond photo.*

Double " Vermorel " nozzle (French make); the caps are made with holes (bevelled on the outside) of three sizes. Each nozzle can be adjusted, by the screw, to spray at any angle.

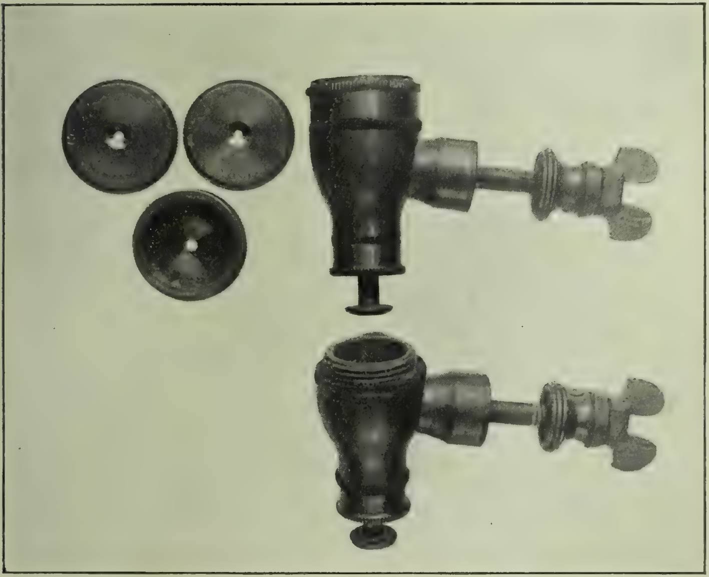
Plate 7.



[*W. H. Hammond photo.*

Double " Vermorel " nozzle (American make), with disgorgers. The caps have very minute openings, and are slightly funnelled on the inside.

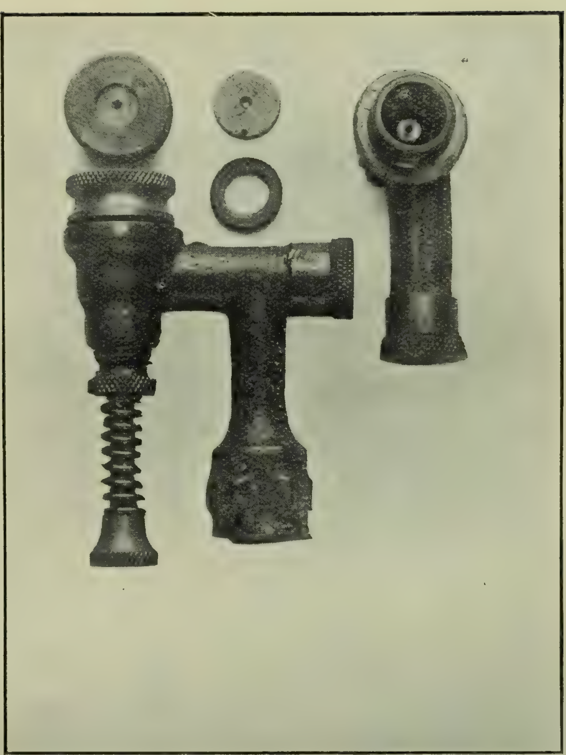
PLATE 8.



[*W. H. Hammond photo.*

"Improved Vermorel" nozzle (English make), with disgorger. The caps are made with holes (bevelled on the outside) of three sizes. The nozzle can be adjusted—by means of the winged screw—to spray at any angle.

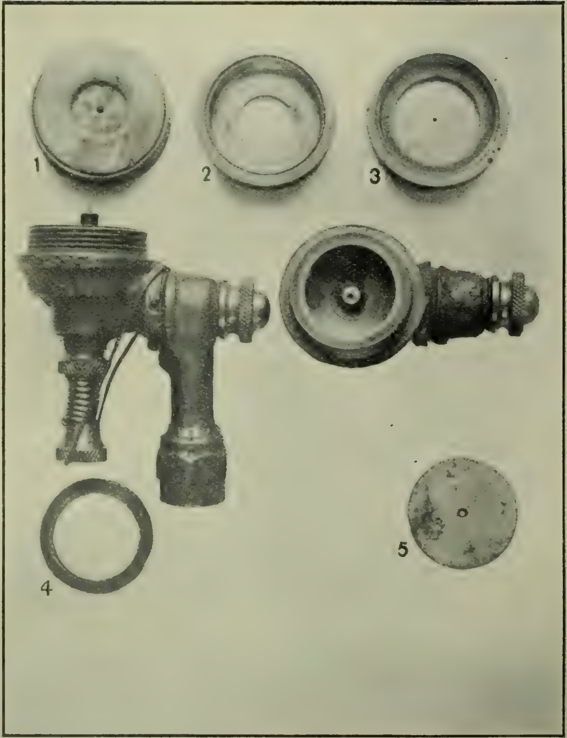
PLATE 9.



[*W. H. Hammond photo.*

" Mistry " nozzle (small pattern ; not adjustable) ; details as in Plate 10.

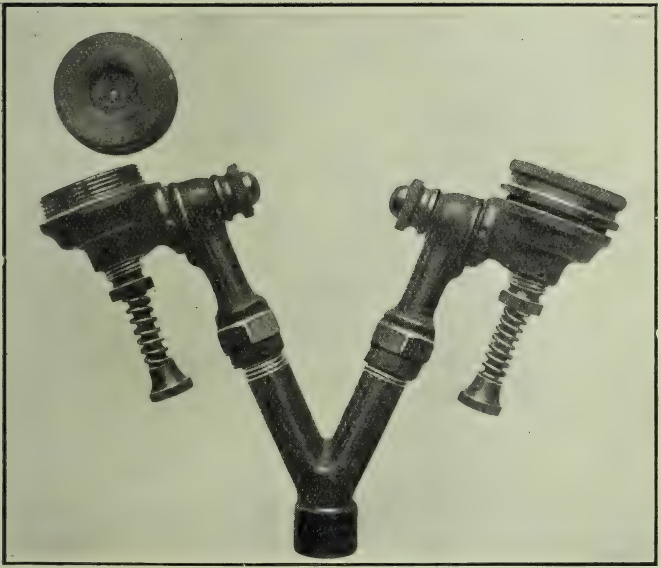
PLATE 10.



[*W. H. Hammond photo.*

" Mistry " nozzle, with disgorger. A removable circular disc (Fig. 5), made of hardened tool steel, with a very minute opening bevelled on the outside, fits into the cap (Figs. 1, 2, 3). The nozzle can be adjusted, by means of a screw, to spray at any angle. Made entirely of bronze.

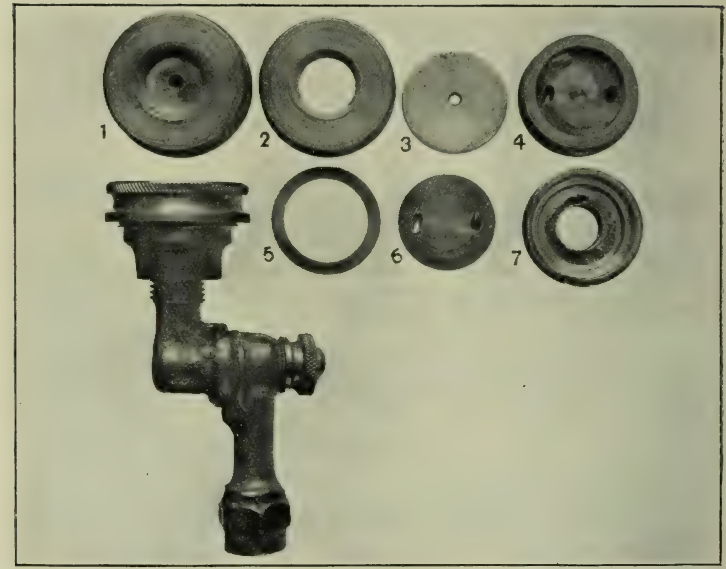
PLATE II.



[*W. H. Hammond photo.*

Two adjustable " Mistry " nozzles, with disgorgers, on a brass Y.

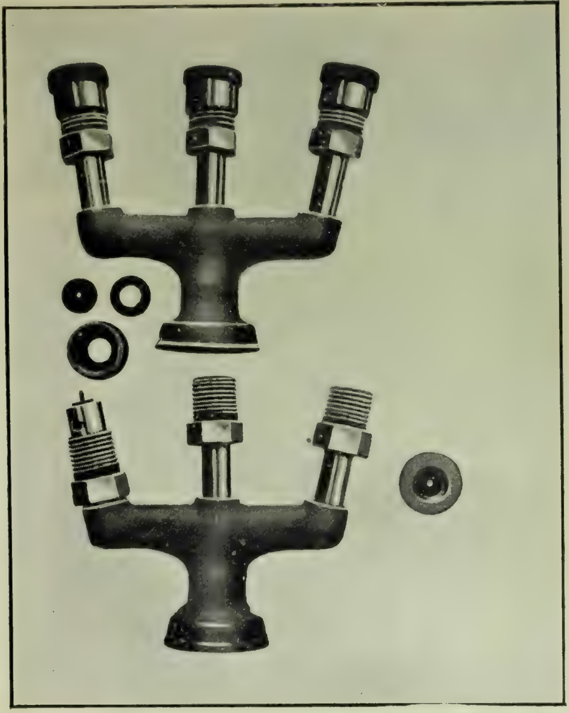
PLATE 12.



[*W. H. Hammond photo.*

" Mistry Junior " nozzle. The fluid is sent up through the opening shown in Fig. 7 ; it is then broken up with a rotary motion into minute jets which escape through the slanting holes in the thick brass disc (Fig. 6), shown in position in Fig. 4 ; above the brass disc is placed, on a leather washer, a thin disc of hardened tool steel with a small opening, bevelled at the edge from the outside (Fig. 3),—by which means the jets are broken up into a smoke-like spray (see Plate 4). The two discs are fixed in position by the screw-cap shown by itself in Fig. 2 ; enclosing the discs, in Fig. 1 ; and screwed in position on the nozzle below. The nozzle can be adjusted, by a screw, to spray at any angle. Made of brass.

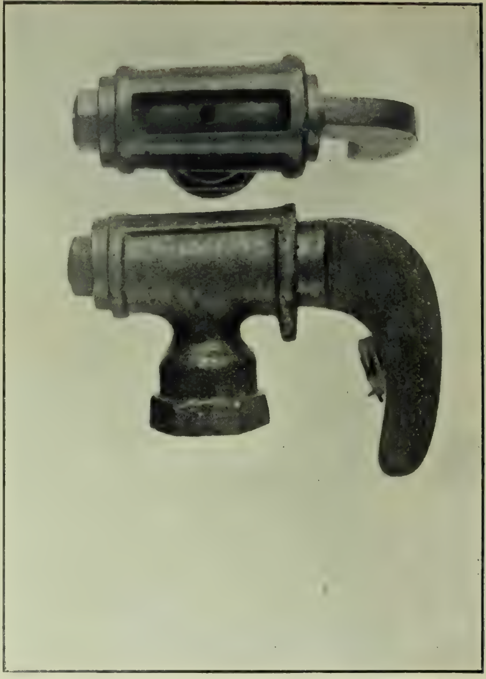
PLATE 13.



[*W. H. Hammond photo.*

"Spramotor" nozzle, a "three-cluster." The cap of each nozzle has a deeply bevelled opening, into which, from the inside, a small perforated disc fits. The nozzle, if blocked, can be cleared at once by a simple and very effective contrivance; each nozzle can be pulled down (as shown (on left) in the lower "cluster") until the disgorger-pin projects through the opening of the disc and so clears it. When in action the force of the spray keeps the nozzle pushed out, as in the upper "cluster."

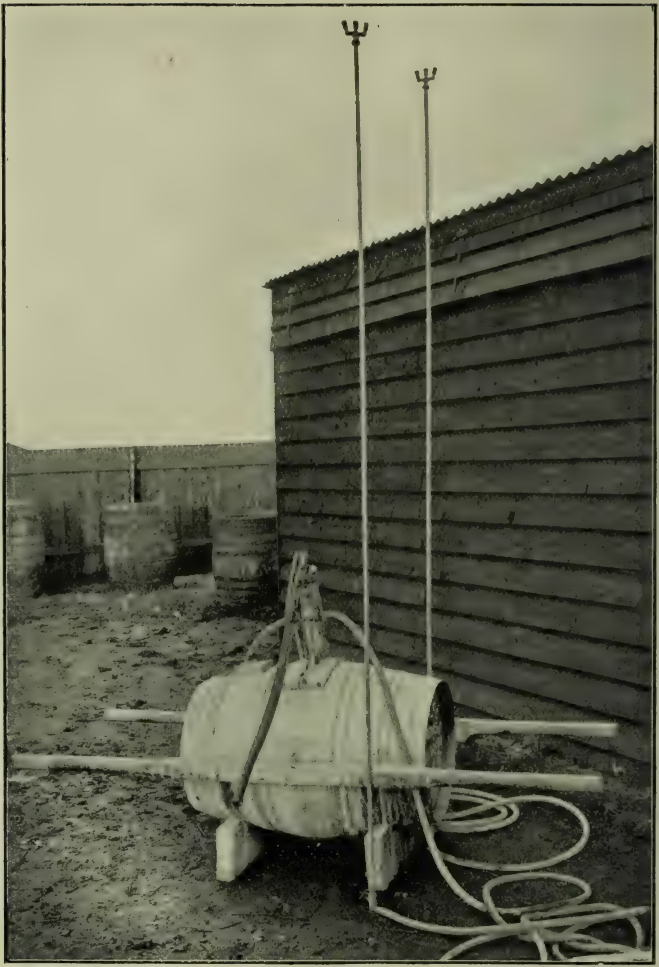
PLATE 14.



[*W. H. Hammond photo.*

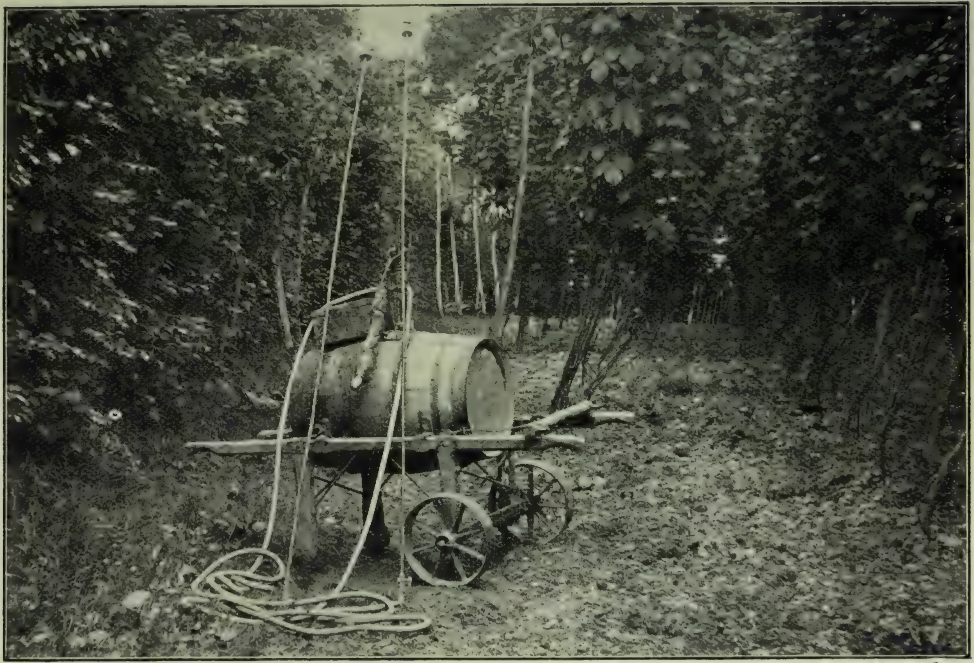
The "Enots" nozzle. This nozzle, and others of a similar type, although sold for use with Bordeaux mixture, are quite unsuitable for the purpose, since they throw a spray of the nature shown in Plate 3.

PLATE 15.



Spraying machine with hand-barrow arrangement (for being carried), "Spramotor" (Canadian) pump and 3-cluster nozzles on iron lances. Suitable for closely-planted plantations.

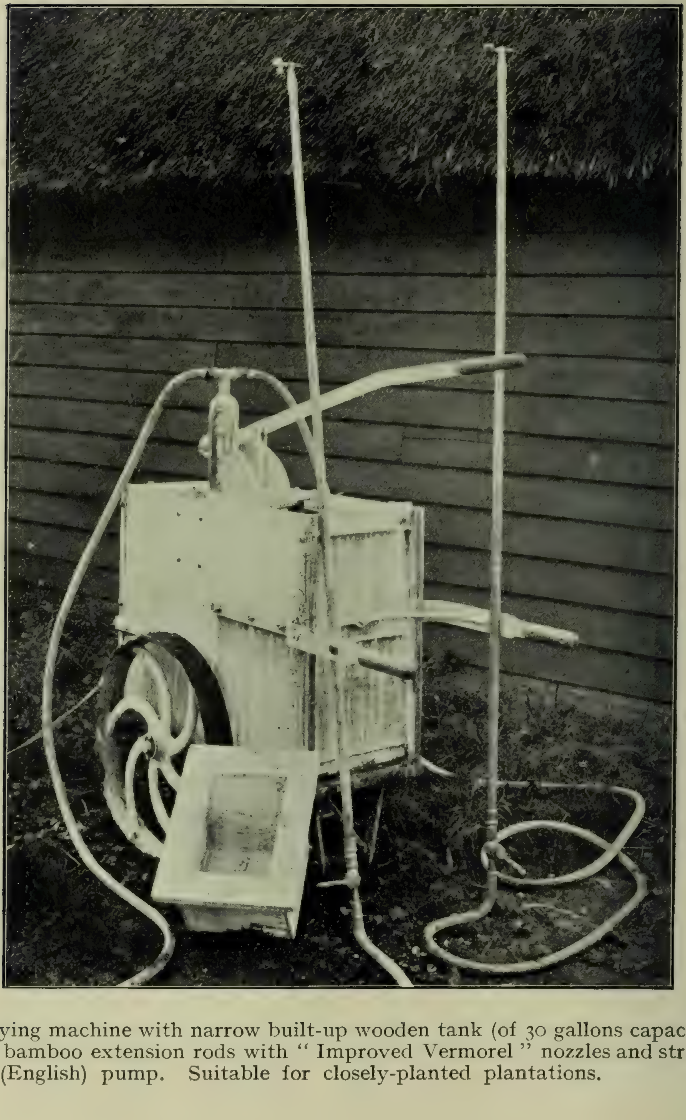
PLATE 16.



[S. T. Parkinson photo.

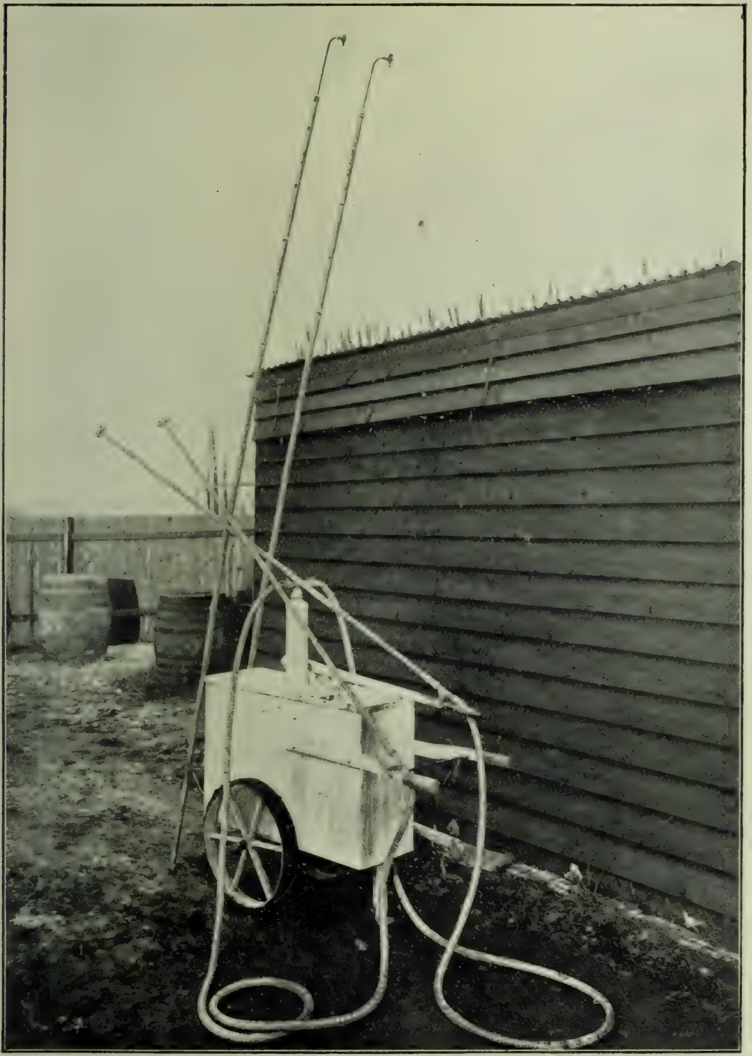
The same make of machine as shown in Plate 15, adapted for use with a horse.

PLATE 17.



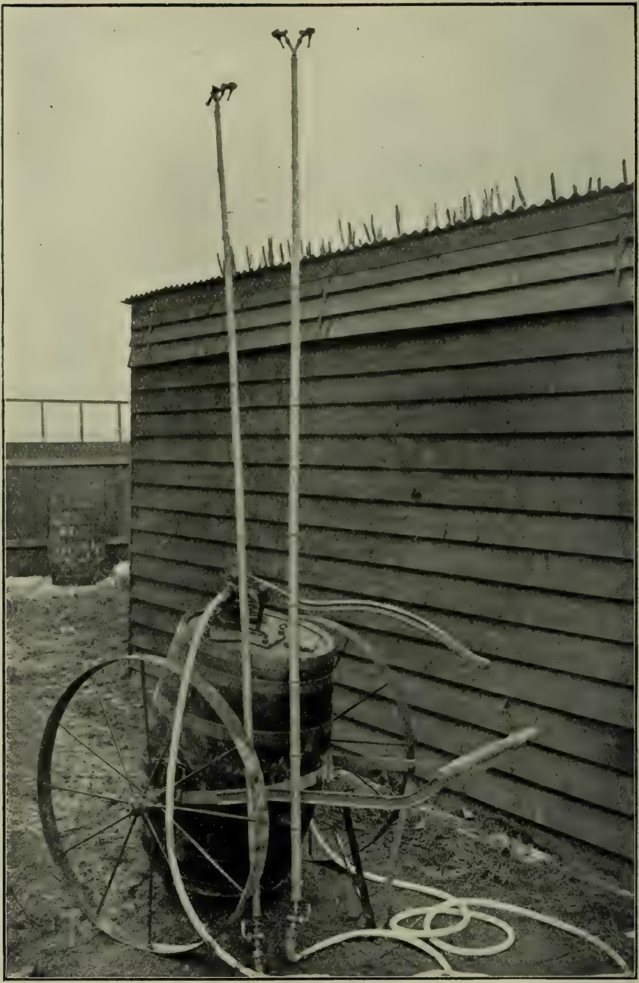
Spraying machine with narrow built-up wooden tank (of 30 gallons capacity), 6 ft. bamboo extension rods with "Improved Vermorel" nozzles and strong (English) pump. Suitable for closely-planted plantations.

PLATE 18.

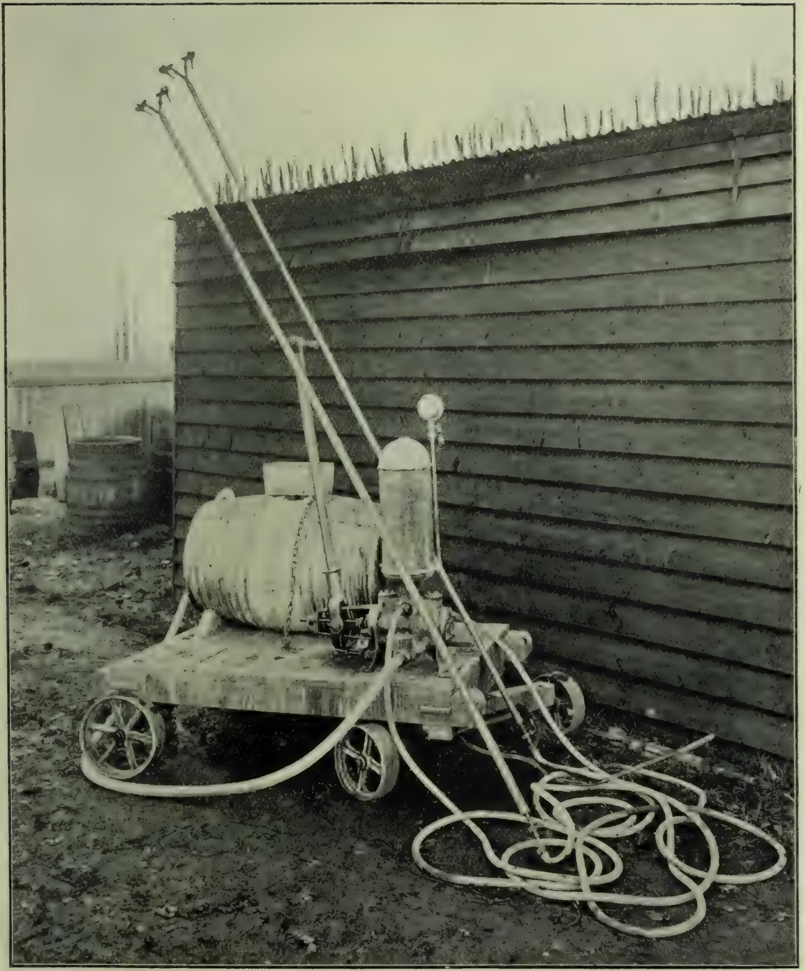


A similar machine to that shown in Plate 17, except that the tank is made of galvanised iron. The short (6 ft.) and long (12 ft.) bamboo extension rods are fitted, respectively, with double and single "Vermorel" nozzles.

PLATE 19.

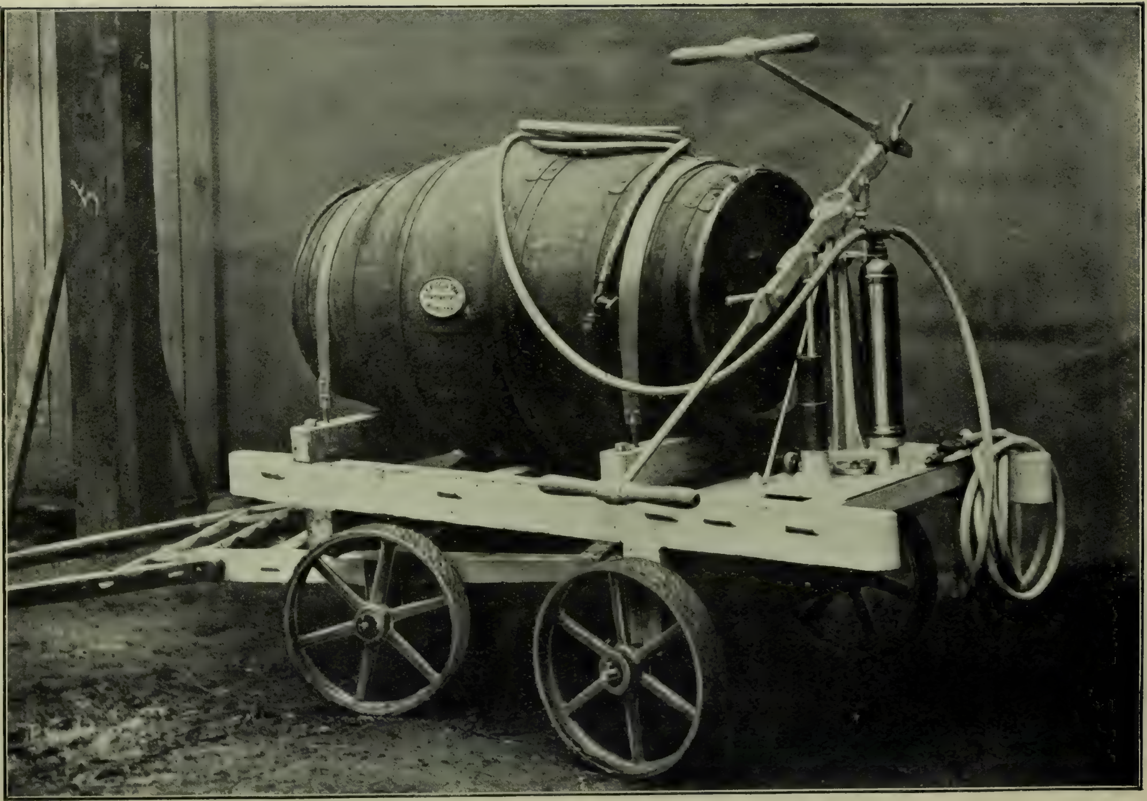


Barrel spraying machine on wheels; with strong (American) pump. The 10 ft. bamboo extension rods are fitted with double "Mistry" nozzles. Suitable for orchards or gardens.



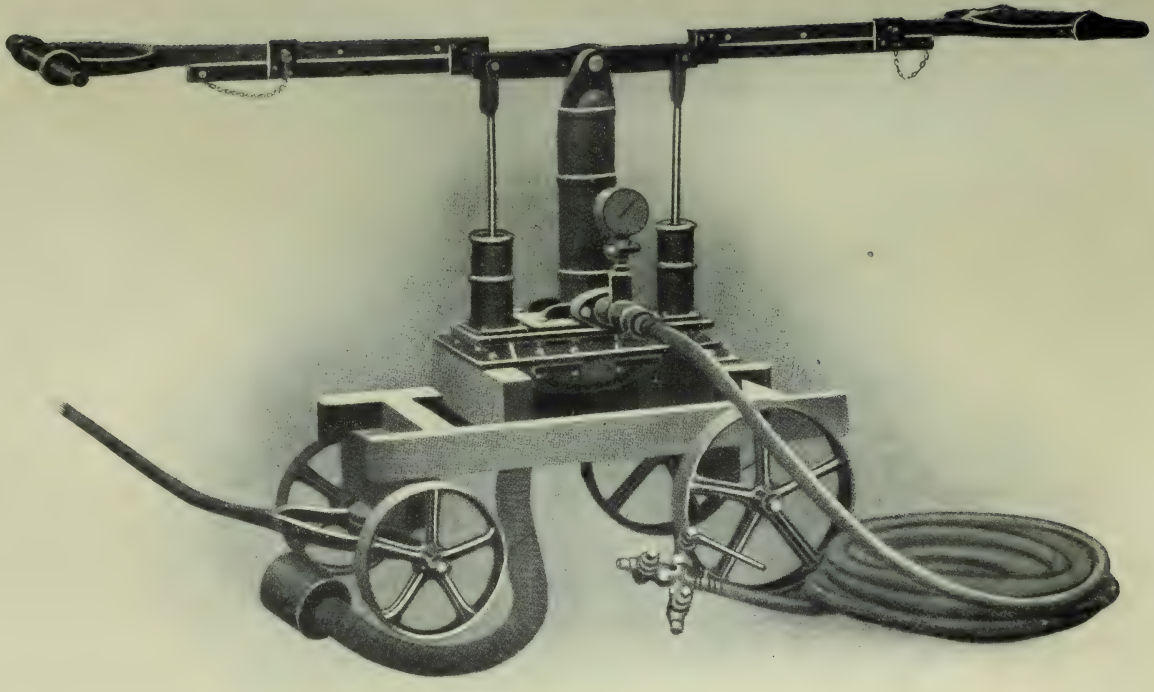
Spraying outfit, consisting of powerful double-acting pump (American) with large air-chamber and pressure-gauge, mounted on trolley with 30-gallon barrel for Bordeaux mixture. For use in orchards with tall trees.

PLATE 21.



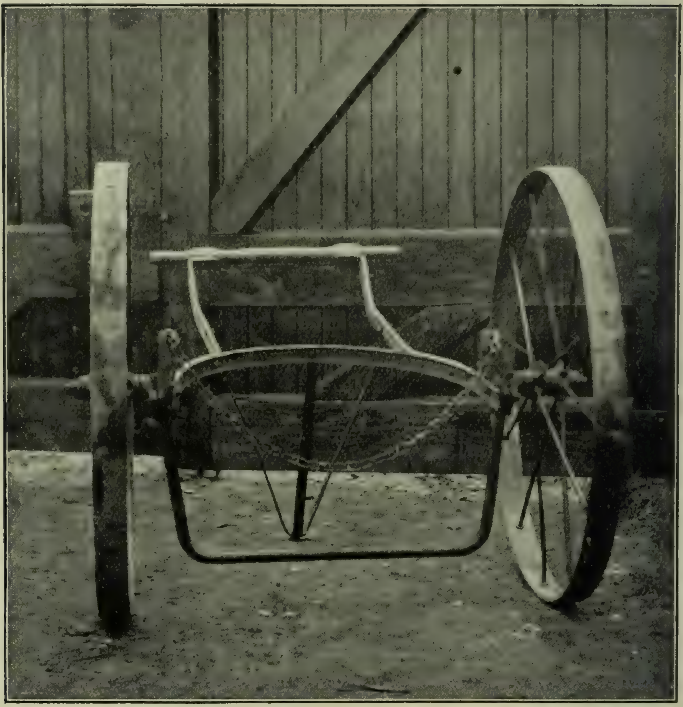
Spraying outfit consisting of powerful double-acting pump (English) worked by two men, and 60-gallon barrel, mounted on trolley. For use in orchards with tall trees.

PLATE 22.



Powerful double-barrel lift-and-force pump (English), with pressure gauge. For use with hose laid down in an orchard or plantation as described at p. 255.

PLATE 23.



[*F. V. Darbishire photo.*

A strong and cheap type of "barrel cart"; any barrel can be picked up and held in place by the adjustable chain (see Plate 19).

## "Black Spot" or Apple "Scab."

(PLATES 24 TO 26.)

In the last number of this *Journal* an illustrated account was given describing the life-history of the fungus which causes the disease known as "Black Spot" or Apple "Scab."* This disease is very prevalent on apples grown in this country, and occurs also in practically all fruit-growing countries. It is the practice, almost without exception, of apple growers in foreign countries, to spray their apple trees with Bordeaux mixture in order to prevent the "scab" fungus from attacking the crop,—as in the same way it is the invariable rule in Continental vineyards for the vines to be sprayed with the same mixture in order to prevent them being attacked and destroyed by the Vine Mildew (*Peronospora viticola*).

During the past season a striking case has come under notice which shows the rapidity with which the disease may spread if no proper steps are taken to check it, and the great loss it may then inflict on the grower. During the summer of 1908, a fruit-grower farming in East Kent brought to the College samples of Peasgood's Nonsuch apples so badly affected with apple "scab" as to be unsaleable (see Plate 26). As this grower had expended much of his capital in planting and raising plantations of these apple trees and of other varieties which were now beginning to be similarly affected, the occurrence of this epidemic of disease signified (as the grower informed me) very heavy losses unless a remedy could be found. The disease had invaded the plantations step by step in the following manner. No attack of "scab" serious enough to attract attention had been noticed until the season of 1906, when it was observed that the apples on the "Peasgood's Nonsuch" trees showed a few "black spots,"—presenting the appearance shown in the photograph in Plate 24. Very probably such isolated "black spots" occurred on some of the other varieties of apples in the plantation. The disease was very slight as yet, however ; the grower remarked that very probably it would not have been noticed that season at all had it not happened that it was his custom to send some " Peasgood's Nonsuch " apples to a " Harvest Festival " held locally, and wishing to send apples without any blemish, he remembers that he had in consequence to select apples from a number of trees because of the occurrence of small " black spots " on many of the fruits. This fact becomes of interest when we see to what extent the disease increased in the following season. In the next summer (1907) a large proportion of the " Peasgood's Nonsuch " apples showed the diseased appearance represented in the photograph in Plate 25. We see here the white, scaly margins to the " black spots " which is so characteristic a feature of the " scab " fungus when it is growing vigorously on the apple. In the season of 1906, the attack was so slight that neither the growth of the apple nor its appearance was affected sufficiently to influence its price on the market ; in 1907, however, the disease was severe enough to affect the growth of the apple, —the affected portion not growing out properly (see Plate 25), —and to ruin its general appearance, so that its market value was depreciated very considerably. The injurious effect of the " scab " on this and some other varieties of apple was so evident in 1907 that the grower decided that the time had come to try some remedy. Unfortunately he did not then apply to the College for information, but put his faith in the proprietary wash " V1," which at that time was being so much advertised as a winter wash which would " absolutely destroy " every fungus spore and insect egg. The affected apple trees were well sprayed with " V1," but, as was not surprising, the money spent was thrown away.* Notwithstanding the fact that the application of "V1" was followed in the summer by the application three times of the "V2" proprietary wash, the disease increased to such an extent that in the summer of 1908 many of the apples were so cracked and "scabbed" by the fungus as to be unsaleable, and unrecognisable as "Peasgood's Nonsuch" (see Plate 26). It was then that the grower sought advice from Wye College. The life-history of the fungus causing the disease was explained to him, and the two important facts pointed out that the same fungus which attacks the fruit and there forms "black spots" and "scabs" occurs also *on the leaves and also frequently on the young wood* of the same or adjacent apple trees, and that it is in these two places where the fungus increases so rapidly, and where it can be dealt with by spraying. A visit of inspection was paid to the plantations (which consist of a considerable number of varieties) for the purpose of ascertaining what varieties were growing "scab"-infested wood, since the severity of the attack and the fact that it was yearly increasing made it practically certain that the source of the disease existed on some of the trees.

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* A Leaflet, which gives also full information as to the cure of the disease, can be obtained on application to the Secretary.

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* The following remarks appeared in the last number of this *Journal*, (1908, p. 313) : " I would specially caution growers against using the expensive and often useless proprietary washes which, now that spraying is slowly becoming general in this country, are being placed on the market and extensively advertised. *In many cases they are quite useless against the disease which they are advertised to cure.* One class of proprietary washes are composed largely of the chemical substances known as phenols, in which category carbolic acid, creosote, and various waste products obtained in the distillation of tar are included. (The fluid advertised as V1 belongs to this class, being largely composed of phenols, or substances of that nature, dissolved in caustic soda.) Such washes contain no copper or sulphur, and cannot be recommended for use against fungus diseases such as apple scab."

The plantations consist of bush apple trees of the following varieties: Golden Noble, Ecklinville, Cox's Orange Pippin, Worcester Pearmain, Domino, Tom Putt, Blenheim Orange, Benoni, Wellington, Jacques Lebel, Cox's Pomona, Allington Pippin, Charles Ross, Royal Snow, Peasgood's Nonsuch, Glory of England, Warner's King, Betty Geeson. A careful examination of the trees in the winter of 1908-9 revealed the fact that *the "scab" fungus existed on the young wood of six varieties and nowhere else, viz.*, on Cox's Orange Pippin (bad), Ecklinville (bad), Golden Noble, Blenheim Orange, Warner's King, and Peasgood's Nonsuch. The grower followed the advice given him to spray all the trees of these six varieties during February with the simple and inexpensive* winter-wash of copper sulphate solution (made by dissolving (in a wooden receptacle) 4lbs. of copper sulphate in 100 gallons of water), and then to spray all the trees with Bordeaux mixture,* first just before the flowers opened, and then again immediately after the bloom had fallen. A third spraying with Bordeaux mixture was given to those varieties which had had the disease especially badly. The result of this spraying was entirely successful; the disease was checked to such an extent that "scab" was visible only to a very small extent on any of the varieties, doing no serious damage anywhere, while no harm was done to any of the trees by the spray. Those varieties, *viz.*, Golden Noble, Tom Putt, Benoni, Cox's Pomona, Allington Pippin, Royal Snow, Glory of England, Warner's King and Betty Geeson which in 1908, and previously, had borne "scabby" crops were now all practically free from "scab." If in future seasons the grower continues this system of spraying at the right time with the right washes it is certain that there will be no recurrence of the injury due to "scab" shown in Plates 24 to 26. If such treatment is given for a few seasons, it will probably be found that young healthy wood will be produced on the above-mentioned six varieties, in which case the treatment can be reduced to one thorough spraying with Bordeaux mixture directly after the fruit is set.

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* The cost of this winter wash is 1s. per 100 gallons. The cost of "V1" fluid was then 10s. 6d. per 100 gallons; it is now reduced to 7s. 6d. per 100 gallons. The experience undergone by growers in connection with "V1" should teach them not to put faith in proprietary washes until they have been tested by capable persons not interested commercially in the matter.

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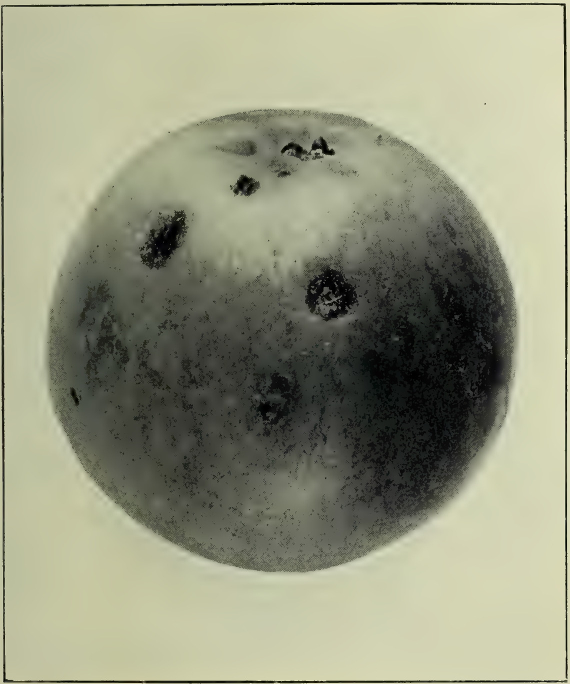
* Bordeaux mixture costs about 2s. 2d. per 100 gallons.

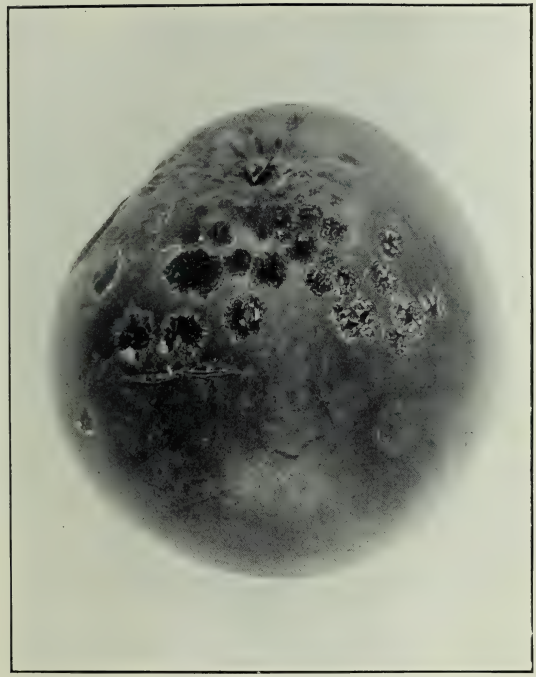
PLATE 24.



[*W. H. Hammond, photo.*

"Scab" on Peasgood's Nonsuch Apple; slight attack.

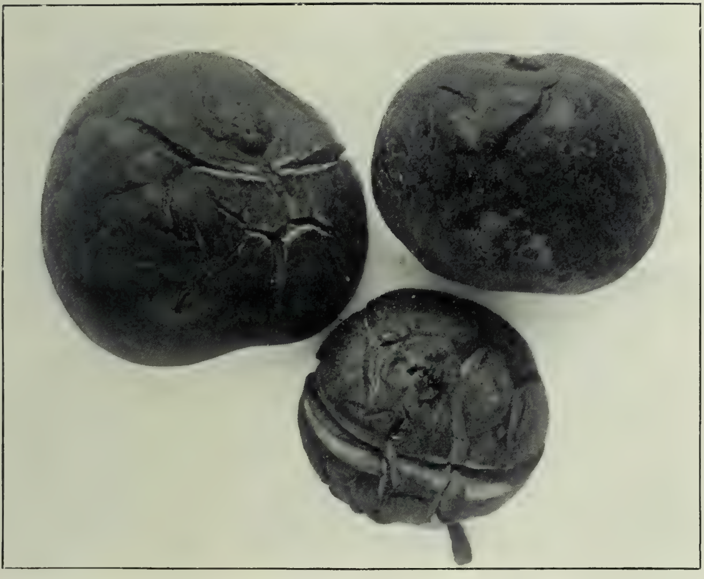
PLATE 25



[*W. H. Hammond, photo.*

"Scab" on Peasgood's Nonsuch Apple; severe attack.

PLATE 26.



[*W. H. Hammond, photo.*

"Scab" on Peasgood's Nonsuch Apple; very severe attack. The disease increased in severity, through the stages shown in Plates 24, 25, 26, in three successive seasons.

## The American Gooseberry Mildew.

(Plates 27 to 30)

(*Sphaerotheca mors-uvae* (Schwein.) Berk.).

In a footnote to my article on this disease in the last number of this *Journal*, I wrote :—" While the present article was in the press, very serious outbreaks affecting several hundred acres have been discovered in Kent." I have now to give the history of the extent and severity of these outbreaks, and of the measures which have been taken in Kent to try to stop the spread of this new disease. Readers who wish to obtain a fully-illustrated description of the life-history of the American Gooseberry Mildew,* and an account of how it was introduced into this and other European countries and of the devastation already caused in many gooseberry-growing districts, can refer to the past numbers of this *Journal*, vol. xv. p. 231 ; vol. xvi. p. 273 and 299 ; vol. xvii. p. 259.

The first discovery of the American Gooseberry Mildew in Kent was in 1906, when I found, in a certain nursery, a number of affected *standard* gooseberries (recently imported from the Continent). Through the good sense of the owner, the whole of the stock was immediately grubbed up and burnt. In this way the outbreak was stamped out.

The next discovery of the mildew in Kent was made on July 4th, 1908, by an Inspector of the Board of Agriculture, in a commercial plantation near Swanley. At the same time the grower forwarded specimens to Wye College. On the next day I visited the plantations (some seventeen acres of which were affected), and also, in company with the Board's Inspector who had discovered them, some other infected plantations in the neighbourhood. It was apparent at once that a most serious outbreak had occurred in this part of Kent. The Board of Agriculture promptly issued (on July 17th) the " American Gooseberry Mildew (Kent) Order of 1908," under which the Kent County Council was able to appoint Inspectors with powers to enter premises in search of the mildew, and to enforce the carrying out of certain measures by the grower in the plantations found to be affected. Mr. T. E. Crompton,—then a student at Wye College, studying horticulture and fungus diseases,—was at once appointed a temporary Inspector by the Kent County Council.

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* This can be obtained, as a Leaflet, on application to the Secretary.

It was due to Mr. Crompton's patient and thorough search of plantations in the Swanley district that the extent of the chief outbreaks was at once able to be ascertained. The County Council were thus at once able to enforce over the affected district the measures embodied in the Board of Agriculture's Order.

Mr. Crompton, on relinquishing the work to take up a fruit farm, was succeeded by Mr. K. G. Furley (who had been carrying out spraying experiments in Worcestershire under the Worcestershire County Council). Soon afterwards, in order that the whole of the fruit-growing districts of Kent should be inspected, Mr. R. S. Vinson was appointed as a second Inspector. Both Mr. Furley and Mr. Vinson are past students of Wye College, with a practical knowledge of horticulture and with the necessary scientific training for carrying out the duties of an Inspector of fungus diseases.

The publication of the " American Gooseberry Mildew Order " for Kent, in which the disease was made notifiable under a penalty, had the effect of making certain growers who had been concealing the disease declare its presence in their plantations. Evidence was gradually obtained showing that the mildew had existed—and, of course, had been spreading—in North Kent for two, or probably three, years before it was officially discovered in 1908. In the case of some of the largest plantations affected, the reason why the grower had not previously declared the presence of the mildew was the fear that the Board of Agriculture would order the compulsory destruction of the bushes without the payment of any compensation.* In some of these cases where the mildew had been concealed, the grower had attempted to cope with it by smothering the bushes at odd times with sulphur, lime, soot, and other substances, but having no knowledge of the life-history of the mildew (especially as to how to deal with it in winter) it was not surprising to hear that the outbreaks in 1906 and 1907 had continued to increase both in severity and area, with the result that the growers who had been concealing the disease were glad to declare it when the " Order " was issued for Kent.

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* See p. 410 of this *Journal* ; also vol. xvii. p. 260.

The " American Gooseberry Mildew Order," issued on July 17th, 1908, required the grower either to destroy the diseased bushes, or if he so preferred, to spray them in summer and prune off the diseased shoots in winter. If the grower decided to destroy the bushes, it was left to the County Council to decide whether any compensation sould be paid to him. It is to be noted that any such compensation would have to be given out of the rates, since no grant from the Treasury was provided,—such as was obtained when the Colorado beetle was stamped out in this country in 1901. In consequence of the extent of the outbreaks when first discovered, and of the fact that *the disease had obtained a firm foothold in certain districts due to the concealment of the disease for several years*, it was obviously impossible for the Kent County Council, without the aid of any grant from the Treasury, to entertain the idea of giving compensation generally, with a view of having all diseased bushes grubbed up and thus eradicating the disease. The grower, therefore, having no hope of compensation, practically always declined to grub up the diseased bushes, and chose the alternative course of spraying and pruning. Later, as we shall see, some *voluntary* grubbing up of diseased plantations has taken place. Thinking, however, that cases might arise where the outbreak was found to be small and circumscribed, and in a part of the county otherwise quite free—in which case the compulsory destruction of all diseased bushes might stamp out the mildew for good—the County Council obtained on August 14th 1908, the " American Gooseberry Mildew (Kent) Order of 1908 (No. 2)," which gave their Inspector power to order the destruction of bushes in cases where he considered it desirable,—the grower *not* having the choice of the alternative of spraying and pruning. In any such case where the destruction of bushes was enforced, the County Council was required to give compensation on a certain scale. As a matter of fact, no occasion for the exercise of such power has arisen, *and no money has at any time been paid from the rates for the purpose of compensation.*

Although no drastic compulsory measures calculated to eradicate the mildew in Kent have, through force of circumstances, been able to be taken, a very great amount of good has been done by means of the measures able to be enforced under the " American Gooseberry Mildew Order." It is entirely through the powers conferred on the Inspectors of the County Council whereby they are able to enforce a considerable amount of pruning and spraying, that it has been possible to combat the spread of the mildew in Kent by a united and systematic effort. The prohibition of *trade in diseased bushes* is one of the most valuable provisions of the " Order," and in those counties which have been required by the Board to carry out the " Order," the search made by the County Council Inspectors in nurseries has undoubtedly done much to prevent the wholesale distribution of the disease over Great Britain by means of the sale of young bushes bearing the " winter-stage " of the mildew.* Had there been no demand by fruit-growers in 1906 and 1907 for an Act† to deal with plant pests, there could have been no control of the American Gooseberry Mildew in Kent‡ in 1908,—with the result that the disease would not only have spread quickly from one end of the county to the other, but would very soon have established itself in cottage gardens, as " big bud " has done.

During 1908 the County Council Inspectors, assisted at times by the Board's Inspectors, searched the main gooseberry-growing districts in Kent. It became clear that in a very large number of affected plantations (outside of certain areas in North-west Kent) *the mildew had only just been introduced. From these numerous centres the mildew undoubtedly spread all through the summer of* 1908 (*continuing up to as late as October* 10*th*), in spite of the spraying that was done in most cases, since as mentioned below, it is extremely difficult to stop the spread of the " summer-stage" of the American Gooseberry Mildew (when growing vigorously) by spraying in summer.

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* Unfortunately, it is to be feared that no efficient search of nurseries has been made in certain counties where the disease is known to exist ; consequently it is probable that the disease is still being sent about the country to some extent (see p. 413).

† The " Destructive Insects and Pests Act," passed into law on July 4th, 1907.

‡ It is unfortunate that no systematic measures have been taken in Surrey (see p. 413).

By November, 1908, the area affected consisted of 1787 acres. In many of the plantations the disease was only slight, but in the parishes of Southfleet, Swanscombe, Northfleet, South Darenth and Fawkham there were 300 acres very badly diseased. In the Swanley District there were 800 acres affected in all, but in a considerable number of the cases the disease was slight. Bad outbreaks were also found in the parishes of Bobbing, Cobham, Cooling, Frindsbury, High Halstow, Higham, Hoo, Lynsted, Rainham, Shorne, Strood, and Teynham.

During the time the mildew was finding its way into Kent, lectures on the life-history of the American Gooseberry Mildew were given by myself at various fruit-growing centres in the county; also at a Fruit-growers' Conference (which about 400 growers attended) held at Wye College on November 27, 1908. Some of the general features attending the first outbreaks of the mildew in Kent were discussed at this Conference, and to avoid repetition I would ask readers of this article to turn to the account given below at page 409 of this *Journal*. In all the lectures given, and in the information conveyed personally to growers by the Local Inspectors, growers have been continually urged not only to carry out the Board's "Order" to the letter, but to take further measures to eradicate the mildew.

Emphasis has been continually laid on the following points connected with the life-history of the mildew :—(1) that owing to the manner in which the *winter-spores* are completely protected by the corky walls of the fruit-conceptacle, *all winter-spraying is simply a waste of money*; (2) that repeated scientific experiments have proved that the simple and cheap wash of "liver of sulphur" solution (costing about 1s. 6d. per 100 gallons) is the most efficacious for use against the summer-stage of the mildew; (3) that while frequent spraying in summer stops the spread of the mildew, the only chance (short of grubbing up the bush) of extirpating the disease is by the drastic pruning off and burning of all diseased shoots in the winter; (4) that in connection with this last measure, *no success can be hoped for unless the pruning is done quite early in the winter*, because, under the influence of the weather in winter, the fruit-conceptacles (*perithecia*)—containing the *winter-spores* of the mildew—which are at first held tightly in the meshes of the brown " scurfy " spawn (*mycelium*) which covers the surface of diseased shoots, gradually drop out and fall to the ground. When this happens, *infection will probably result in the following spring—no matter how thoroughly the pruning may have been done late in the winter.* The fruit-conceptacles which have fallen to the ground open during the spring months and set free the *winter-spores*, which are carried by the wind to the young leaves of the gooseberry and at once infect them.*

Advice emphatically given was at that time specially necessary with respect to the points (1) and (2) mentioned above. In an official circular which was issued, the Board advised growers to use Bordeaux mixture "when the disease is dormant," that is, as a winter-wash, "with the object of destroying any external mycelium or adhering spores that may be present." *As a matter of scientific fact there is in winter no living mycelium to be killed, nor are there in winter naked spores anywhere adhering to the plant;* and as Bordeaux mixture is quite unable to penetrate to the *winter-spores* through the corky walls of the fruit-conceptacle (*perithecium*), *the growers who sprayed as thus suggested literally wasted their money.* In the Board's " Annual Report " published in December, 1909, we find the error corrected in the following words: " There appears to be no evidence that either copper sulphate or Bordeaux mixture is capable of penetrating (the walls of the fruit-conceptacle) under the ordinary conditions of spraying."

A regretable consequence of the suggestion that winter-washing was efficacious was the encouragement it gave to firms selling proprietary washes to entice the grower to waste his money on worthless proprietary winter-washes "guaranteed" to cure American Gooseberry Mildew. One of the many proprietary washes, extensively advertised for the purpose and utterly useless, sold at 10s. 6d. per 100 gallons, and was probably extensively used in many counties, though not, I think, in Kent.

With respect to summer washes, a similar course of events occurred. In spite of the fact mentioned above that scientific experiments had proved that a *freshly-mixed* solution of "liver of sulphur" is the most effective wash known, the Board gave, in all the "American Gooseberry Mildew Orders" issued from 1907 to 1909, the Local Authority (County Council) of each county the right to decide what fungicide was to be used in the compulsory spraying. The natural result was that the clerks to the various County Councils concerned were presented with samples of a great number of proprietary washes, and in many counties (though not in Kent) proprietary spray-fluids in which the "liver of sulphur" was not freshly mixed and was only one of several constituents, were officially sanctioned for use. Thus, at the critical time when the American Gooseberry Mildew was just breaking out in England, and when compulsory spraying was introduced for the first time in this country, the use was officially sanctioned of proprietary fluids which were more costly* and whose properties had not been scientifically tested,—although a cheap spray, well tested by repeated scientific experiments existed. The right of choosing the nature of the fungicide to be used in all compulsory spraying should be vested in the Board of Agriculture (as is the case where sheep-dips are concerned). This mistake, which I pointed out as soon as it was made, was not rectified until the issue of the 1909 American Gooseberry Mildew Order (now in force), under the provisions of which the County Council no longer remains the judge of what spray is suitable to be used.†

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* The County Inspectors now report that growers are beginning to realise that pruning must be carried out early if it is to be of any use in exterminating the disease.

In respect of these two matters alone, viz., the uselessness of winter-washes, and the cheapest and most efficient summer-wash, the Inspectors of the County, by carrying to the growers personally exact scientific and practical information, have undoubtedly been the means of saving fruit-growers in Kent from wasting considerable sums of money.

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* One of the summer washes which was approved for use by certain County Councils *cost the grower* 8*s.* 6*d.* *per* 100 *gallons;* supposing that this contained the right quantity of potassium sulphide in the right chemical condition it would be as effective against the mildew as the well-known wash of potassium sulphide and water which the grower can easily make for himself *at the cost of* 1*s.* 6*d.* *per* 100 *gallons.*

† For further details, see this *Journal*, vol. xvii. p. 263.

To return to the subject of the extent of the outbreaks of the mildew in Kent. By the end of the winter 1908-9 the affected area in the North-west Kent district (including Swanley) was known to be 1,234 acres (excluding seventy-seven acres which had been voluntarily grubbed up) ; in the rest of Kent the affected area stood at 920 acres (not including 62½ acres which had been voluntarily grubbed). Thus the County Council Inspectors were confronted with an affected area of 2,154 acres, over which they had to enforce more or less drastic winter-pruning. This outbreak of disease on so extensive a scale was due partly to the short-sighted policy of a few growers who had concealed the presence of the mildew in their plantations for some time. *During* 1908, *a year most unfavourable for spraying* (*which was the only measure under the Order that could be enforced in the summer*), *the mildew extended its area of infection by hundreds of acres.* During the winter of 1908-9 the Inspectors visited as many plantations as possible in the fruit-growing districts throughout Kent, and in this way it was found that *an area of* 1,513½ *acres in Kent is still free from any trace of American Gooseberry Mildew.* To prevent this area from becoming infected through the spread of the mildew must be one of the chief aims of those carrying out the "American Gooseberry Mildew Order."

At the end of the summer of 1909 we were in a position for the first time to obtain some idea of the result of the campaign in Kent against the mildew, as during 1909 the County Council Inspectors were able to keep practically all infected areas under observation, and, also, while carrying out their duties under the "American Gooseberry Mildew Order," to collect valuable data.

It will be instructive to give here some of the detailed information obtained by the Inspectors. In Mr. K. G. Furley's district (which includes, roughly, the county of Kent, except the North-West part round Swanley) the acreage affected in 1908 was 920 acres ; over this acreage the compulsory measures as set out in the Order were of course enforced,—besides in many cases the growers being persuaded to take more drastic measures,—*with the result that the disease reappeared in* 1909 *in only* 488½ *acres of such area.* Still more encouraging are the details with regard to the lessened severity of the disease in the affected area in 1909, as compared with 1908.

The following Table gives this information :—

| | Bad, *i.e.*, 40% and over of bushes affected in the plantation. | General, *i.e.*, 40% to 15%. | Slight, *i.e.*, 15% to 1%. | Few, *i.e.*, 1% to a few bushes. | Total Acreage. |
|---|---|---|---|---|---|
| | acres | acres | acres | acres | acres |
| 1908 | 225 | 149 | 230 | 316 | 920 |
| 1909 | 130 | 65 | 148 | 145½ | 488½ |

There is no doubt that the action of several growers who, realising the dangerous nature of the disease, have taken far more drastic measures than are at present required by law, has done much to reduce the infected area. For instance, the acreage of gooseberries and currants voluntarily grubbed in the present district in 1908 was 62½ acres, and in 1909 11 acres.

Referring to the above table, we see that in 1909 only 130 acres were "badly" infested, as against 225 in 1908. Now nearly 80 of these 130 acres are in the district of Southfleet, and belong to two growers ; that is to say, there are only about 50 acres "badly" infested in the rest of Kent (excluding the neighbourhood of Swanley).

The total acreage of infested plantations in the district, given in the Table, is 488½ acres ; to this must be added 43½ acres discovered in 1909, fresh outbreaks having occurred, or been discovered, at Cooling, Sutton Valence, Swanscombe, Wye, Lynsted, and Hadlow. In six of these new cases affected areas, involving 17¼ acres, have been created by the removal of bushes (under licences) from nursery beds affected last year. *The affected area for this district now actually stands at* 529 *acres.**

Taking the same district, *the number of plantations* affected in 1908 was 356 ; in 1909 the mildew reappeared in 143 of these, the remaining 213 plantations are now waiting to be declared "free" by the Inspector (if no trace of disease is found in the final examination), and all restrictions will then be removed from them.†

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* Owing to several nursery beds having been reduced in area.

† 145 plantations have been actually freed (up to February 11th, 1910).

It is important to note that in many plantations where no reappearance of the disease occurred in 1909, *the measures adopted by the growers in* 1908 *were as follows :*—in slight cases, where only a few bushes were affected, *the diseased bushes were grubbed up and burnt,* while in cases where the disease was worse, tipping of all the shoots was carried out.

If now we take the Swanley district and the N.W. portion of the county (excluding the neighbourhood of Southfleet), we find the following state of affairs, as set out in Mr. R. S. Vinson's report :

In 1908 the infected area was 1,234 acres, not including 77 acres which were voluntarily grubbed ; at the end of 1909 this had been reduced to 887 acres.* Comparing the proportion of cases as regards severity of attack in these two years, we obtain the results shown in the following Table :—

| | Bad, *i.e.*, 40% and over of bushes affected in the plantation. | General, *i.e.*, 40% to 15%. | Slight, *i.e.*, 15% to 1%. | Few, *i.e.*, 1% to a few bushes. | Total Acreage. |
|---|---|---|---|---|---|
| | acres | acres | acres | acres | acres |
| 1908 | 393 | 231 | 378 | 232 | 1234 |
| 1909 | 122 | 84½ | 250 | 430½ | 887 |

Here, again, we have the satisfactory result that not only has the acreage of infested plantations been reduced, but the intensity of the disease over the existing infected area has been greatly lessened by the measures which were either enforced, or were voluntarily adopted. To the infected area of 887 acres, an addition of 71 acres freshly infected, or discovered to be so during 1909, has to be added—*making a total for this district of* 958 acres.†

In the above Table we see that 393 acres are scheduled as having been " badly " infested in 1908 ; in the case of several of the plantations concerned the winter-pruning in 1908-9 was

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* In the greater part of the 347 acres in which the disease did not reappear in 1909, it had been classified in 1908 as "slight," so that one would appear to be justified in expecting a further reduction in 1910.

† 29 acres of this infected area have now been voluntarily grubbed, reducing the total to 929 acres.

"passed" by the Inspector with the comment "unsatisfactory,"—meaning that although the bushes had been gone over several times by men pruning, *there was still some disease present on the young shoots.* The result of this in 1909 was as follows :—to quote Mr. Vinson's words : "Out of 14 plantations, which were not pruned satisfactorily last year, 10 are again *badly diseased—in fact, these cases account for a little over half of the whole area* (*122 acres*) *which is badly diseased this year.*" This is a very significant fact, and shows clearly that *unless drastic measures are enforced as regards pruning in the winter* (*to remove all traces of the winter-stage of the mildew*), *no real progress towards the extirpation of the disease will be made.*

In the present district there were 403 cases in 1908, and only 203 in 1909, to which, however, 26 fresh cases have to be added, making a total of 229 cases. These 26 fresh cases, which account for the fresh infected area of 71 acres (mentioned above), are made up of the following cases : (1) 33 acres consist of young bushes *which were known to be infected in the nursery in* 1908, and which were planted out (under licences); (2) 27 acres consist of certain plantations which were first inspected (in 1908) after ordinary pruning had been carried out, and as no disease was apparent then, were considered to be free ; (3) 11 acres concern plantations which were not visited last year.

During 1909, a very thorough inspection of the fruit-growing districts round Ash-next-Sandwich, Deal and Minster was made by Mr. C. J. Alexander, who was temporarily appointed as an Inspector. Only four outbreaks of the mildew in this district had been discovered in 1908, namely, three at Grove Ferry and one at Ash, but this number probably did not represent the full extent of the disease during 1908, as the district had not been thoroughly examined, and some of the examination had taken place after pruning had been done. After a very close examination of all plantations (covering over 550 acres) Mr. Alexander found the mildew in 16 cases, affecting 12 acres. Twelve of these cases were very slight, two of them, indeed, concerned only one bush. The cases are situated in the following parishes :—Ash-next-Sandwich 10, Stourmouth 2, Woodnesborough 1, Staple 1, Wingham 1, and St. Lawrence Extra 1.

In both the cases in which only one bush was affected that bush was at once grubbed, *and the disease did not appear afterwards on any neighbouring bushes*. Besides these, a piece of about a quarter of an acre of badly diseased gooseberries and red currants was grubbed, but in this case the mildew had apparently already infected neighbouring areas.

The very thorough examination of the gooseberry-growing area in this district was made with the object of warning the large number of growers of the new danger threatening this crop, and also of stamping out the first outbreaks which might have occurred. It was desirable to make a special effort to preserve the health of the gooseberry plantations (comprising some 550 acres) in this district, where the early season makes gooseberry-growing specially profitable. The results of Mr. Alexander's search showed —in the discovery of 16 small outbreaks—that the disease had already invaded this part of Kent. The source of these outbreaks cannot be traced ; there has been, apparently, no planting up of diseased bushes in the district, nor has the infection been caused through the medium of baskets ("returned empties"). We are driven to suppose that the *summer-spores* (*conidia*) of the American Gooseberry Mildew are carried to a considerable distance by natural agencies, such as the wind, or insects (*e.g.* bees), or possibly by animals (hares, rabbits, or even birds). The disease being spread in this way, it is clear that so long as infested areas exist in any part of Kent all the outlying districts where the gooseberry plantations are still free will be continually exposed to the danger of being infected.

The danger of infection to which gooseberry plantations are now exposed in many parts in Kent is very clearly illustrated by what has happened to the College fruit plantation (at Wye) during the last year. On the College farm (at Wye) is a small plantation of gooseberry bushes, planted among apples and other fruit. It is, perhaps, almost unnecessary to say that all precautions have been taken for many years past to prevent the accidental introduction of the American Gooseberry Mildew into this plantation, and for this reason no young bushes obtained from an outside source have been planted in it during the time. Up to 1909 the bushes were certainly free from the mildew. So far as is known, the whole neighbourhood round Wye was free from the mildew until 1908. In that year the disease was found in two places about a mile to the W. of Wye. Investigation of these outbreaks showed that in all probability the American Gooseberry Mildew was introduced into one of the plantations concerned *by means of diseased young bushes obtained from certain nurseries in North-West Kent known to be badly infected.* The second outbreak at Wye—consisting of some young bushes—is almost certainly to be accounted for by the fact that the diseased bushes had been obtained as cuttings from the above-mentioned plantation. During the summer of 1909 the mildew reappeared in both the above places, *and at the end of the summer was discovered in the College plantation.* It is practically certain that no infection was brought by human agency, and we must conclude that the wind, or possibly insects (*e.g.* bees), or even perhaps birds, carried the *summer-spores* (*conidia*) of the mildew to the College plantation, a distance of a mile or more from the infected plantations to the W. of Wye. Notwithstanding the fact that Wye College from the first has adopted every precaution to keep clear of American Gooseberry Mildew—it will be remembered that it was at the Fruit-growers' Conference held at the College on November 7th, 1906, that the first Resolution was sent up to the Board of Agriculture to try to awaken them to take some action—yet by 1909 the mildew found its way to the College plantation.

Such cases as the above—and a large number of these have occurred in Kent during the past three or four years—demonstrate the fact very clearly that when a new infectious plant-disease is introduced into a country, all fruit-growers are liable to suffer losses caused by its attacks, no matter what precautions they take *individually*; in such cases prompt *State* action, dealing with infected areas before the disease can spread, is absolutely necessary to ward off the danger. Such assistance will not, in my opinion, be available in this country until fruit-growers can obtain a Horticultural sub-Department at the Board of Agriculture.

There are one or two further points of interest in the County Inspectors' reports which may be noted here. Both red and black currants (four cases of each in separate localities) have been found attacked by American Gooseberry Mildew. As a rule currants have been only slightly attacked on the foliage, but in two of the cases the red currants have been severely attacked both on the young leaves and on the young shoots. In all cases the currant bushes which became affected stood among, or by the side of, severely attacked gooseberry bushes.

Certain varieties of the red currant appear to be more susceptible *locally* than others. In the case of three separate plantations at Swanley, Rochester and Sittingbourne, the varieties attacked have been Victoria, Raby Castle, and Long Bunch. In another case—in Norfolk—which I investigated, the variety attacked was the Grape. In one plantation in Kent rows of the two varieties Raby Castle and Victoria adjoined gooseberry bushes virulently attacked by American Gooseberry Mildew; after a close investigation the mildew was found only on the Victoria bushes, having apparently completely passed over the Raby Castle bushes, without being able to attack them,—notwithstanding the fact that the bushes of these two varieties of Red Currant were growing intermixed and that the variety Raby Castle had been found to be attacked in plantations in other districts. In this particular case there were indications that the mildew has only just passed on to the Victoria red currant bushes from the gooseberries,—that, so to speak, the mildew was here just beginning to learn how to attack red currants. It was clear that the mildew had not yet perfectly adapted its parasitism to the new host-species, since it was not uncommon to find on the red currant leaves small patches here and there, which were brown and dead, as the result, apparently, of the too fierce attack of the mildew. A similar phenomenon has been observed in the case of rusts when they pass on to a new host-species to which their parasitism is not perfectly adapted.

In the case of the black currants which were attacked, the variety was "French Black."

It would appear, from the experience of the County Council Inspectors in Kent, that while no variety of gooseberry is immune, some varieties are more susceptible to the attack of the mildew than others. The *most susceptible* varieties appear to be Keepsake (Berry's Early Kent), Crown Bob, May Duke, Lancashire Lad; less susceptible are the varieties Whitesmith, Yellow Rough (Golden Lion), Whinham's Industry, Cozen's Seedling, Keen's Seedling, Rifleman, Greengage, Goldfinder, Warrington.* There seem no grounds, unfortunately, for thinking that any of the varieties at present in general cultivation are immune to the attacks of the American Gooseberry Mildew ; if this disease is to be combatted in the future by the cultivation only of " immune " or " resistant " varieties, these will have to be specially raised by a plant-breeder at some Horticultural Institution.

Thirteen cases have occurred in Kent, in which the green fruit was infected, and in three of these to a serious extent. In one case the Inspector was obliged to serve notice on the grower, prohibiting the picking of the crop except under certain conditions. In some of the other cases, where only a few berries in a plantation were affected, the rest of the crop had to be picked at once in order to prevent a general infection.

To proceed now to summarise the position :—it can be said, I think, that the measures which have been, and are being, taken in Kent against the American Gooseberry Mildew appear to be holding the disease in check. It must be remembered, however, that this success has been largely accomplished through the work of the County Inspectors,—Mr. T. E. Crompton in 1908, and since then by Mr. K. G. Furley, Mr. R. S. Vinson and Mr. C. J. Alexander. By giving scientific reasons—and often by persuasion—the Inspectors have induced a large number of owners of infected plantations to take drastic measures. Thanks to them, and to the co-operation and good sense of the great majority of fruit-growers in Kent,† *we*

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* In the Board's Report the following note appears, as to the general susceptibility shown by varieties in the various counties affected with the disease :—Keepsakes have proved to be the most susceptible ; Lancashire Lads and Crown Bobs are among the next, while Golden Drops are liable to be attacked on their berries and that at all stages of growth, owing to their thin skins. Careless is usually fairly resistant.

† The course of events had not been so pleasant in other counties. The following account is taken from the Board's Report, and refers to the period 1908-9 : " There were still some persons who refused to attend to their gardens as required, and as the time was fast approaching in which the work of pruning would be useless, it was decided to prosecute a certain number of offenders in each district. The County Councils of Worcestershire, the Isle of Ely and Norfolk, accordingly took action almost simultaneously and obtained convictions in each case. In Worcestershire the defendants were fined £3 and costs, and £1 and costs respectively ; in the Isle of Ely they were fined £2 and costs and £6 and £1 10s. costs respectively ; and in Norfolk they were fined £5 and £1 costs, and £10 and £1 costs respectively. At another prosecution in the autumn of 1908, the defendant in a case in Worcestershire was fined £2 and costs."

*stand at the beginning of* 1910 *with an infected area of* 1,451 *acres, as compared with* 2,514 *acres at the beginning of* 1909. *Thus more than* 1,000 *acres have been freed from the mildew.* There is one important point, however, to be remembered. The area of 1,513½ acres of gooseberry plantations found to be free from mildew in 1908-9 has not yet been re-examined ; until this is done it is impossible to say whether the mildew during the past summer of 1906 has been extending into fresh districts. If it has not done so to any serious extent, it is clear from the above statistics that (considering the many unfavourable circumstances commented upon above) very satisfactory progress has been made. The hope for the future must be that fresh measures can be enforced which will stamp the disease out district by district until Kent is again free.

These satisfactory results have not been obtained without considerable sacrifice on the part of growers. In the first place some thousands of pounds have been spent on labour, for spraying and pruning an affected area of some 2,000 acres ; secondly, the severity of the winter-pruning which has been necessary in many of the affected plantations has caused a decrease of crop in the following season ; thirdly, it must be remembered that 179¾ acres* of gooseberry plantations and nurseries have been grubbed up without any compensation having been received. The fact has also to be mentioned that a considerable sum of money—amounting to £889 15s. 2d.—taken from the rates, has already (up to the end of 1909) been expended in carrying out the " American Gooseberry Mildew Order " in Kent. An *annual* expenditure out of the rates of a considerable sum of money will apparently have to be incurred for some time.

Having regard to these heavy expenses which have been incurred by growers, and also by the county rates, in dealing with the American Gooseberry Mildew in Kent alone, and remembering that similar expenses have been incurred in nearly all the fruit-growing counties† of England (*the infected area of gooseberries in Great Britain*

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* In certain cases the bushes were old and in the ordinary course of events would have been grubbed up in the following year ; here, of course, the loss was slight as compared with that involved in the grubbing up of bushes that were young or in full bearing.

† According to a Report of the Worcestershire County Council, sent to the Board of Agriculture in December, 1908, the number of gooseberry bushes

*in April*, 1909, *standing at* 8,733 *acres*), it is somewhat curious to find, in the Board's Report, just issued, the remark, "it seems doubtful if American Gooseberry Mildew is as serious a disease as some of those who have studied the fungus would have us to believe." The price which the fruit-growing counties are being called upon to pay as the result of inaction during the years 1900 to 1907 is a pretty stiff one.

It is not surprising to find that the fruit-growers and ratepayers in general in those counties which have now to expend considerable sums of money to combat the disease are beginning to apply to the Treasury for financial assistance to help them to bear the expense. At a recent meeting of the Canterbuy Farmers' Club and East Kent Chamber of Agriculture the following Resolution was passed: "That this Chamber considers some part, at least, of the cost of the County Council's action [whereby an expenditure of £889 15s. 2d. has been incurred in carrying out the Board's 'American Gooseberry Mildew Order'] should be met out of Imperial funds."

There is a real danger that while in Kent growers and the County Council are expending considerable sums of money to combat the mildew, other counties, including those adjoining Kent, will not adopt similar measures. If this is so (and there is reason to believe that no efficient control of the mildew has been taken in Surrey, Sussex, and perhaps in Essex) (see p. 412), Kent will be continually exposed to the danger of fresh sources of infection being introduced from other counties, and the money of growers and of the ratepayers will largely have been thrown away. As I have previously pointed out, this new disease should have been treated as a matter of *national* importance, and not as merely as of *local* concern. A second Resolution passed at the meeting of the

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destroyed in that county under the "American Gooseberry Mildew Order of 1907" was 24,525, besides about 10,000 one-to two-year-old bushes, and that under the Second Order issued in 1907 about 67,500 bushes were burnt, the greater number being old bushes which the growers preferred to grub up rather than be at the trouble (and expense) of pruning and spraying. The following is the list of counties which are definitely known to be infested by American Gooseberry Mildew:—Gloucestershire, Worcestershire, Herefordshire, Warwickshire, Shropshire, Leicestershire, Derbyshire, Northamptonshire, Norfolk, Lincolnshire, Cambridgeshire, Huntingdonshire, Kent, Essex, Surrey, Sussex, Middlesex, and Berkshire.

Canterbury Farmers' Club, above mentioned, was to the effect "that the Kent County Council be invited to approach other County Councils in the gooseberry-growing districts, with a view to united action in regard to the question [of the expenditure out of the rates in connection with American Gooseberry Mildew]." It is sincerely to be hoped that all County Councils concerned in the matter will soon meet, and then take strong and concerted action.

Let us now consider the measures which, as the result of experience gained in 1908 and 1909, have been found most successful in Kent in combating the American Gooseberry Mildew.

We must first briefly consider the life-history of this mildew. In its "summer-stage," represented in Plate 27, the mildew is *white and powdery*, and very similar in appearance to the hop mildew or rose mildew. The "powder" consists of millions of minute spores (*conidia*), each of which is able, like the seed of higher plants, to give rise to another distinct individual, *i.e.*, to another patch of mildew. These spores (*conidia*) are very light, and are blown by the wind. or carried by insects or perhaps animals, to a considerable distance. As soon as a spore reaches the surface of a healthy gooseberry leaf or berry, it infects it, and produces in about a week a small patch of mildew, which in favourable weather rapidly increases. In the "summer stage" of the mildew, the disease is consequently highly infectious; if nothing is done to prevent it, the mildew will produce week after week fresh powdery patches consisting of millions of its spores (*conidia*), and by means of these will infect gooseberry bushes (and it may be red and black currants as well) for a considerable distance around. It is probable that a diseased plantation, if neglected, will spread infection to bushes within a mile's radius. *All through the duration of the "summer-stage" (i.e., while the mildew is white and powdery)—a stage which may last from May* right through summer into the beginning of October—the mildew will spread and increase the area of infection if no preventive measures are taken.*

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* The reappearance of the mildew in affected plantations may take place any time during the month of May, or as late as June. In 1909 the first case in Kent was found on May 24th. If the weather is mild and wet the grower should be on the look-out from May 1st. The worst cases of sudden outbreaks of the mildew, followed by the rapid development and the spread of the "summer stage," have occurred in May, June and July.

The first establishment each season of the "summer-stage" of the mildew on the leaf or berry of a gooseberry is always due to this *having become infected by a winter-spore of the mildew.* How the *winter-spores* arise we shall see later. If at the time when this infection is taking place, which happens during May and June, the bushes are well sprayed, or rather drenched, with a solution of "liver of sulphur,"* the first specks of the white "summer-stage" of the mildew resulting from the germinating *winter-spores* will be killed, and the bushes saved from becoming infested. It is more profitable for the grower to spray his affected plantation every ten or fourteen days during the latter part of May and through June, than to wait later until the "summer-stage" of the mildew is well established for the season and then to spray occasionally.† When once the "summer-stage" is well established in a plantation, that is to say, when once most of the shoots of the bushes become covered with the white mildew, it is most difficult and expensive to reduce the amount of disease by spraying, although spraying may considerably check its spread to surrounding plantations. In a showery season frequent sprayings are, unfortunately, of little avail, because the "liver of sulphur" solution is washed off at once by rain, and re-infection on the young growth all over the bushes is continually taking place in such weather by means of the summer-spores which have not been killed by the spray. At the time of the discovery of the first outbreaks in plantations in Kent, viz., in July, 1908, the showery weather (which lasted through the summer of this year), made it practically impossible to combat the spread of the mildew by spraying. To mention one definite instance. The first case was discovered on July 14th; the bushes in the affected plantation were covered with the powdery and most infectious "summer stage" of the mildew. In such a stage, as we have seen, the mildew is capable of spreading the disease on the wind to all surrounding plantations. Spraying was at once ordered, and though the grower wished to do all that was possible to combat the disease, the weather made his efforts of no avail. From a record which I kept of the weather conditions in the district in question, I find that heavy showers of rain fell at frequent intervals on July 15th, 16th, 17th, 18th and 19th. In the intervals between these showers the mildew undoubtedly spread considerably; and this happened in this district over some thousands of acres of gooseberries. It is for the reasons given above that the American Gooseberry Mildew is so difficult a pest to deal with in summer, and that for any hope of success reliance has to be placed almost entirely on the carrying out of measures in winter to destroy the winter-stage.

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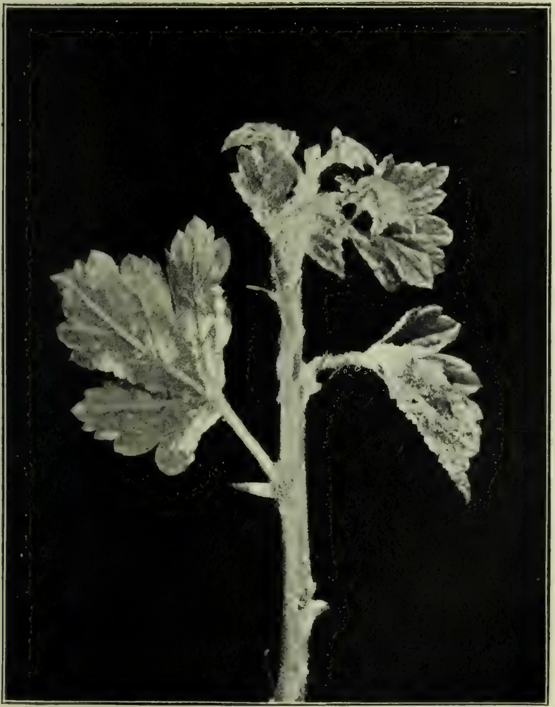
* The strength of this solution should be 1 oz. of "liver of sulphur" to two gallons of water in spring months and during dull weather in the summer, and the same amount to three gallons of water during sunny weather in summer.

† This is true also in respect of the closely-allied apple mildew (*Podosphæra leucotricha*).

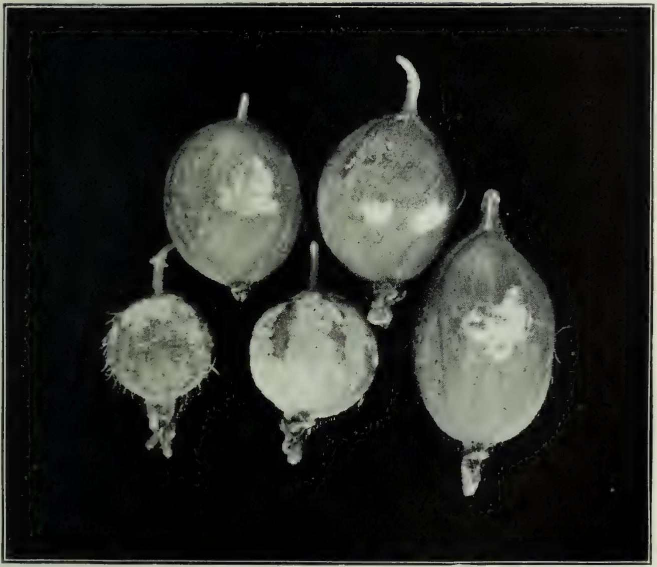
In some seasons the young green gooseberries become infected and show the "summer-stage" before this appears on the leaves. In Plate 28 we have a photograph of some green berries showing the "summer-stage"; the middle berry in the lower row is almost completely invested by the white spawn (*mycelium*) of the mildew. *Directly any white spots of mildew are observed on the berries,—even if none is visible on the leaves—the bushes should be drenched with the "liver of sulphur" solution, as these spots are a certain sign that the re-infection of the gooseberry bush by the winter-spores is taking place.*

With regard to the actual work of spraying bushes affected with the "summer-stage" of the mildew, it must be pointed out that *too fine a spray should not be used.* If one employs a very fine, drifting, "smoke"-like spray—such as should be used when applying Bordeaux mixture—it will be found that its minute drops will not have thoroughly *soaked* the mildewy spots, but will have remained *on the surface of the "powdery," actively-growing patches*, because the air which surrounds the countless number of *spores* (of which the "powder" is composed) prevents the minute drops of a drifting spray penetrating to the surface of the leaf. In such a case only the outermost layers of spores are killed by the "liver of sulphur" solution, with the result that in a day or two the mildewy spots are again powdery with freshly-formed spores, and the disease again begins to spread. A spray with enough force behind it to make the drops reach the surface of the leaf is essential for success; the "Vermorel" nozzle (with a cap of the medium —or largest—sized hole (see Plates 5, 6), or a "Seneca" nozzle, set as finely as possible (when the nature of the spray will be as shown in Plate 3), is suitable for the work. The Vermorel



[*W. H. Hammond, photo.*

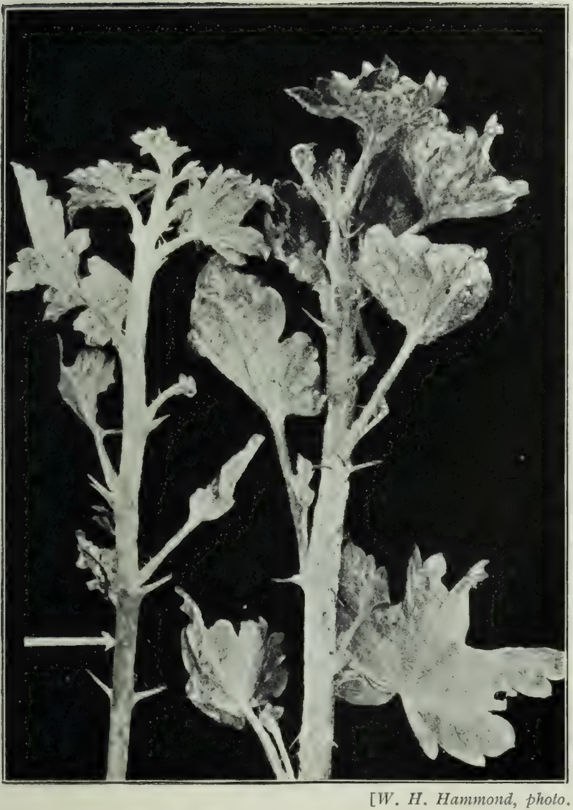
Gooseberry shoot with the young leaves and their stalks, and the surface of the upper part of the stem, covered with the "summer-stage" of the American Gooseberry Mildew. In this stage the disease is highly infectious and spreads very rapidly; early spraying should be done to prevent this condition arising. Specimen from Kent.



[*W. H. Hammond, photo.*

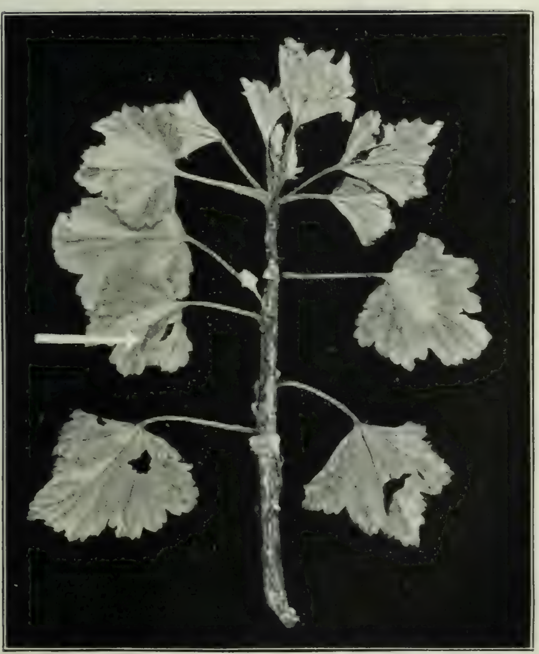
Green berries attacked more or less severely by the American Gooseberry Mildew in its "summer-stage." Specimens from Kent.

PLATE 29.



[*W. H. Hammond, photo.*

Diseased Gooseberry shoots showing the American Gooseberry Mildew passing from the "summer-stage" into the "winter-stage." In the shoot to the left the upper part is infested with the white "summer-stage," while lower down on the shoot (at the place indicated by the arrow) the brown felted "winter-stage' is forming. In the shoot to the right the brown "winter-stage" is forming on the upper part. Specimens from Kent.



[*W. H. Hammond, photo.*

Shoot of Red Currant attacked by the American Gooseberry Mildew. On the (under) surface of the leaves can be seen numerous white patches of the "summer-stage"; at the spot indicated by the arrow the brown "winter-stage" has been formed.

"Eclair" knapsacks, if on the backs of men who will pump energetically, are satisfactory, but owing to "liver of sulphur" having a chemical action on the copper of the ordinary knapsack, ultimately destroying it, the machine sold under the name of the Vermorel "Eclair Etamé," (in which the surface of the knapsack is tinned over), must be used if much spraying is done with "liver of sulphur." If there is room enough in the plantation to use a spraying machine of the type shown in Plates 17, 18, the work of spraying can be carried out far more efficiently than when knapsacks are used.

There is one further point in connection with the subject of the spread of the mildew by the spores produced in its "summer-stage" which must be mentioned here, viz., the possibility of the disease being introduced into a plantation by means of these spores adhering to empty baskets, *i.e.*, to "returned empties." The period during which a mature summer spore remains alive and capable of causing an infection is about a week; if the spore does not reach, within this time, a leaf or young shoot or berry of a gooseberry which it can infect, it dies. It is possible, therefore, that baskets which are contaminated with the disease by having contained mildewed berries, or by having spores blown on them when standing among mildewed bushes, may be sent back empty and used within a week in some healthy plantation which would thus be exposed to infection from spores from the baskets. In all the cases that I have investigated in which the grower has attributed the source of the outbreak to contaminated "returned empties," I have not obtained evidence establishing this source of infection. The Board of Agriculture, however, from the evidence obtained by their Inspectors, consider that "returned empties" are a real danger. They state: "There is scarcely room to doubt that 'returned empties,' which have been in contact with disease have frequently introduced it into uninfected plantations in districts where the disease had not yet obtained a foothold." Under the circumstances, therefore, it will be well for growers, in those cases where danger is apprehended from "empties," to disinfect the baskets immediately on their return and *before taking them into the plantation*, by just dipping them in and out of a "liver of sulphur" solution (1 lb. to 24 gallons of water), or a copper sulphate solution (1 lb. to 25 gallons of water).

To proceed now with the life-history of the mildew. The "winter-stage" of the mildew—which is formed during the summer and autumn months—is so-called because it is in this stage that the mildew forms its *winter-spores*, by means of which it is enabled to live through the winter months. In this winter-stage the mildew is no longer white and powdery and infectious, but is brown and felted, and with *dormant* winter-spores (*ascospores*). In Plate 29 we have a photograph showing the formation of the winter-stage on affected gooseberry shoots. If we look at the shoot to the left we see that the upper part of the stem is coated over with the white "summer-stage" of the mildew, while in the lower part of the stem—at the place indicated by the arrow—the spawn (*mycelium*) of the mildew is beginning to turn brown and to become felted. On examination this brown felted spawn is found to contain, entangled in its meshes, thousands of the fruit-conceptacles (*perithecia*), each of which encloses eight winter-spores (*ascospores*). The *perithecia* and *ascospores* have been fully described and figured in this *Journal*, Vol. xvi.* The re-infection of the bush in the spring is always caused by one of these *ascospores* finding its way to the young leaf or green berry, which it infects and then, within five or six days, gives rise to a small powdery patch of the infectious "summer-stage."

Besides its formation on the stem, the "winter-stage" may also be developed on the berries, on which it forms the same brownish, "scurfy" patches of spawn. I have not seen any formation of the "winter-stage" taking place on the leaves of the gooseberry,† but as first pointed out in 1908 (see p. 412), such may be the case when Red Currants are attacked. In Plate 30 we have a photograph showing a diseased shoot of a red currant; the under surface of the majority of the leaves bears white powdery patches of the "summer-stage" of the mildew, and on one leaf—at the place indicated by the arrow—the brown "winter-stage" has been formed.

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* A Leaflet fully illustrated, dealing with the life-history of the American Gooseberry Mildew, can be obtained on application to the Secretary.

† In the Board's Report, however, such cases are stated to have occurred, though it is not mentioned in what county or counties. The account given is as follows:—"It was also observed that young leaves attacked by the American Gooseberry Mildew bore winter-fruits on the leaf-stalk and on the base of the lamina where the veins spread in a fan-shaped manner. These young leaves were found to have dropped in the middle of August in bad cases, the tips of the branches being thus left quite bare. It follows from this that the soil must get infected with winter-spores, and that the infection may begin as early as the month of August." *This infestation of gooseberry leaves by the winter stage* would, if at all common, be a very disturbing factor from the economic point of view, since obviously the subsequent pruning off of any diseased shoots of bushes affected in this way on their leaves as well, would be of little or no use in combating the disease; the destruction of all

The only measures which can be taken against the winter-stage of the American Gooseberry Mildew is the collection of the parts on which it is formed and their destruction by burning. All the diseased shoots bearing any trace of the "winter-stage" should be pruned off from the gooseberry bush and promptly burnt. This work must be done quite early in the winter,—if possible by the end of October—as otherwise there is great danger of the fruit-conceptacles (*perithecia*) with their contained winter-spores (*ascospores*) falling to the ground and thus constituting a source of infection during the following spring.‡ Where berries are attacked these should be promptly collected and burnt, since any berry with patches of the "winter-stage" on it which falls to the ground may form a source of infection in the following spring, and may then render any work of pruning that has been done almost or quite useless. Where red currants are attacked, the special danger exists which has been pointed out above (p. 292), and also at p. 412.

As some misapprehensions exist, it may be well to point out here the facts as regards the existing regulations affecting the importation of gooseberry and currant (black and red) bushes. At one period, starting from November, 1907, the importation of gooseberry and currant bushes was absolutely prohibited by law. Whilst the law still remains the same with respect to gooseberries, currants are now allowed to be imported under a licence obtainable from the Board of Agriculture.

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affected leaves before some had fallen and infected the soil would be practically impossible—unless of course, the bushes were grubbed up. Considering the importance of the matter, and the possibility that the mildew may be gradually adopting some change in its habits, it is unfortunate that the Board give no information as to the percentage of cases in which the "winter stage" was found on gooseberry leaves, nor as to the varieties of gooseberry concerned. In Kent both the County Council Inspectors and myself have searched for the winter-stage on gooseberry leaves, but have so far failed to find it.

‡ The Board's Inspectors report as follows:—"From observations made on affected twigs during the winter months, *it seems probable that in most cases of mildew the soil must become heavily infected by the month of February*."

# "Wart Disease" or "Black Scab" of Potatoes.*

(*Chrysophlyctis endobiotica* Schilb.).

Plates 31 to 35.

*Life-history of the Fungus and Description of the Disease.*

In a Leaflet† issued from the College in December, 1907, and widely distributed,—as well as in the last number of this *Journal*,—I gave an illustrated account of the appearance and nature of this new and most destructive potato disease, and of the life-history (as far as it was then known) of the fungus *Chrysophlyctis endobiotica* which is the cause of the disease. In this account no mention was made of the manner of germination of the "resting sporangia," since this was not then known. Through the important discovery made by Professor T. Johnson, announced in November, 1908, this gap in the life-history of the fungus is now filled. The following is taken from Professor Johnson's account given in the *Scientific Proceedings of the Royal Dublin Society*, Vol. XII., p. 134 (1909) : On germination the wall of the "resting sporangium" splits, and the contained zoospores escape. "Each sporangium contains hundreds of more or less pear-shaped uniciliate zoospores. As the zoospores are being formed, the large central fat globule disappears, being broken up into innumerable minute globules which are absorbed by and reappear in part in the individual developing zoospores. When looking for sprouting sporangia, I had an experience one day (November 20th, 1908) of sufficiently general interest to deserve a detailed account. I saw several zoospores rushing very rapidly backwards and forwards through the field of the microscope. I found next an elliptical sporangium with a small hole in its wall at one end. The sporangium was practically full of zoospores swarming most vigorously and crowded round the opening in the wall in what looked like a general wild rush to be amongst the first to escape into the fresh air dissolved in the surrounding water. Within a minute the sporangium was emptied. The motion of the zoospores through the field of the microscope was comparable to that of a mouse in a room ; and the rough analogy is not lessened by the fact that the pear-shaped zoospore moved with its single cilium behind. Some of the zoospores were caught between the glass-slide and cover-slip and became stationary. The body of the zoospore (1.5—2.4 $\mu$ in diameter) was actively amœboid, going through changes of form too rapid for me to sketch in succession. The cilium remained either straight or became curved like a carriage-whip, and usually moved passively with the body of the zoospore, though it also showed slow sweeping movements backwards and forwards. Suddenly the body would be seized with a violent spasmodic fit, shake itself free (or not) from its temporary imprisonment, and swim away. The amœbidity of the body of the zoospore and comparative passivity of the cilium were striking. . . . As our knowledge stands at present we are left to hypothesis to account for the entrance of the parasite into the potato-plant. The general assumption is that the zoospore, whether it comes from the summer- or the resting-sporangium, on reaching the potato-tuber, bores its way into the young epidermal cells of the tuber at one of the eyes, and there begins its destructive work."

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* The name "wart disease" is preferable, since it is not only more descriptive, but the alternative name "black scab" is liable to be confused with two totally distinct diseases, viz., the "common scab" (caused by *Oospora scabies*), and the disease caused by *Rhizoctonia*, which is called "scab" in certain districts.

† This can be obtained on application to the Secretary.

With regard to the continued reappearance of the disease in soil when this is once infected,—due to the presence there of resting-sporangia,—Professor G. T. Malthouse, of Harper-Adams Agricultural College, has made the following statement (in a Leaflet issued in October, 1908) : "Various reports have come to hand as to the time that the sporangia or 'seeds' of the disease will remain alive in the ground. The longest period reported to me is *eight* years, the disease reappearing after that time, though no potato crop was on the land in the interval. This is of great importance to those who grow field crops, as it indicates that it is unsafe to plant potatoes on land known to be infected before a lapse of at least eight years."

In the Wye College Leaflet mentioned above, a detailed description has already been given of the manner in which the fungus attacks and destroys potatoes, and as to the way the disease is gradually being distributed over the country in the absence of any Order of the Board of Agriculture prohibiting or controlling the sale of infected "seed" tubers. An interesting case illustrating one of the ways in which the disease may be spread is given in the *Report of the Intelligence Division* (*of the Board of Agriculture*) *for* 1908, p. 12: "When disease has been introduced through the manure, it is usually found distributed throughout the field or garden, or in a definite area where a certain load of manure was spread. The fatal practice of utilising diseased potatoes as food for pigs or cattle in a raw state is accountable for the spread of disease in this way. A slight infection produces distorted potatoes. These are thrown to the pigs, and the manure spread on the fields, but as the spores pass through the intestines of the swine uninjured, the process simply results in the infection being restored to the soil. One instance showing the danger of infection by manure may be quoted. A certain dairy farmer got one of his fields very slightly infected, but failing to recognise the disease, he fed the small and diseased potatoes to his cattle. The next year half his potato field was dunged with manure from his own yard, half with artificial manure. *The potatoes manured with his own yard manure were all so badly diseased that he lost four-fifths of his crop;* the other half of his field was practically free. As he was feeding his cattle last year in the same way, and had turned them out on clover ley he will also have infected a third field. On a smaller scale disease has been conveyed to many gardens by manure contaminated by diseased potato parings, and cases are known where infected peelings have been taken by cottagers to small dairy farmers to feed the cattle, and some of the resulting infected manure has been returned to the same and other cottage gardens."

I should like to take this opportunity to urge all growers of potatoes to be on the look-out for the *first signs* of this disease. The illustrations given in Plates 31 to 35 show the disease in various degrees of severity. Plate 31 represents a " seed " tuber showing a very slight infection ; here the disease has caused the formation of only one very small " wart " (indicated by the arrow in Plate 31) close to one of the eyes of the potato. Now even such a minute " wart " as this contains many thousands of the *sporangia* of the fungus*, and if such an infected tuber is planted, some of the resulting tubers (and probably also some tubers on the neighbouring plants) will present the appearance shown in Plate 32, that is to say, several larger " warty " excrescences will be found growing out of the tuber. If potatoes continue to be grown in the same ground,—and especially if the affected tubers or their " warts " are allowed to rot in the ground—the disease will rapidly increase in severity, and the following season many of the tubers will present the appearance shown in Plates 33 and 34. Here not only are the " warts " of such a size that a great part of the tuber is consumed, but *these large warts usually turn soft and " rot " before the crop is lifted*, with the result that the soil becomes literally infested with countless millions of the " germs " (*sporangia*) of this disease. Then after a year or two, the wholesale destruction of the crop results, the greater number of the tubers being turned into the wrinkled mass of disease shown in Plate 35,—the tubers looking more like pieces of coke than potatoes. *When the soil becomes thus infected, it is impossible to grow a healthy crop of potatoes in it even after a rest of eight years.*

The series of diseased potatoes shown in Plates 31 to 35 were sent to me by a farmer in Lancashire. This farmer had observed the disease in his fields steadily increasing in severity season after season, from the stage shown in Plate 32 until, *in five years' time*, the total destruction of the potato resulted, as shown in Plate 35.

It is practically certain that such infestation of farm land will occur in future years in Kent and Surrey unless drastic legislative measures are taken to deal with the present infected areas.

*Continued spread of the disease.*

In this *Journal* for 1906 I emphasised the necessity of the Board of Agriculture taking immediate steps to stamp out " wart disease" in those localities (then comparatively few) where it was known to exist. The disease has since steadily increased both in area and severity, and the following details show the state of affairs which now exists in one of such infected areas.

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* These are described and figured in the Wye College Leaflet mentioned above.

One of the counties in which outbreaks were reported as long ago as 1902 is Lancashire. No action was taken, with the result that the disease both increased in severity and extended its area, until by 1908 the outbreaks were so bad that they attracted general attention. The local press* described the situation as follows: "The prevalence of that insidious potato disease—'wart disease' or 'Black Scab'—is becoming a serious matter to the farmers in the Ormskirk district. It can safely be asserted that on very few farms in the immediate neighbourhood of Ormskirk, at all events, is its presence absolutely unknown. Though a comparatively new disease to scientific experts, we have ascertained that it was noticed some fifteen years ago on a farm in Aughton, close to the Ormskirk boundary, but at that time it was regarded more as a curiosity than anything else. At intervals since then the 'Black Scab'—for it has no resemblance to the ordinary scab which is often found on potatoes—has been occasionally discovered, but it was not until a couple of years since that any seriousness was attached to the disease, and even then it was not given that attention by farmers which such a matter warranted. As a result of this apathy the disease has secretly and insidiously made progress to such an extent that the whole potato-growing area in the district can be said to be threatened with attack. What this means to the agricultural industry of our neighbourhood only farmers can accurately gauge, as the potato crop is by far the most profitable of the farmer's assets, and even a curtailment of the acreage allotted would be nothing short of a district calamity. There is no exaggeration about the matter. 'Black Scab' is prevalent in the district to an alarming extent, and unless stringent measures are adopted by the authorities and farmers a serious situation must ensue."

The following interesting account of a tour of inspection of the district is given:—

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* *The Ormskirk Advertiser*, August 27th, 1908.

" Our attention being called to the existence of the disease in a field at Aughton, we forwarded some of the affected tubers to the Agricultural Department of the County Council, Preston, and on Tuesday, two of their lecturers, Mr. R. C. Gaut (agriculture) and Mr. J. G. Murray (horticulture) visited the district to make investigations with a view to suggesting some remedial measures. The field referred to is situate in Back Moss Lane, and tenanted by Mr. William Rothwell, one of our most progressive farmers, who on discovering the disease determined to make no secret of the matter, and at once gave the information which led to the lecturers' visit. Several local farmers and others interested had been notified of the visit, and quite a representative company awaited their arrival. Mr. Rothwell had a number of roots dug up, and there was no mistaking the disease, which, however, was mainly confined to one portion of the field, though in odd places other affected tubers had been found. Some of the drills were very badly diseased, several roots having absolutely no potatoes on them at all, the only attachment being clumps of scab, which was most unsightly to look upon. The growth was so virulent on some roots that it had grown through the tops of the drills. Other plants were more or less affected, showing different stages of the growth of the scab, and only in very rare instances was a root dug up which bore no traces of attack. A curious part of the matter is that the tops are fresh looking and as healthy as need be wished, which renders the disease all the more mystifying. The field, which is about nine statute acres, is of black loamy soil, perhaps a little on the light side, and the potatoes are from Scotch seed, sawdust manure having been used. Last year it grew potatoes, followed by winter cabbage, and Mr. Rothwell stated that he noticed a slight attack of it then, but not to an extent that gave cause for any alarm. The crop (Up-to-Dates) is an excellent one, with the exception of this portion of the field, but even there the yield is satisfactory as regards size, only many of the tubers have these ugly excrescences on them.

" Mr. John Tyrer, of Green Lane Farm, Burscough, was present, and stated that he had some fields affected (particulars of which are given below). A number of residents of Long Lane were also present, and testified to having the same trouble in their gardens.

Two of the latter were subsequently visited, and here the disease was seen in a more pronounced form than ever, root after root being pulled up without a vestige of potato being seen—only the ugly attachment—and naturally the tenants are much concerned in the matter. All the gardens were more or less affected last year, but it was thought that the disease would disappear with the introduction of new seed. Such, however, has not proved the case ; in fact, the plots are much worse, which serves to show that unless remedial measures are taken in one form or another the disease spreads rapidly.

" The journey was continued to Netherton and Sefton, where in several cottage gardens more evidences of the dread disease were brought to our notice. As in Aughton, the worst affected tubers were Up-to-Dates, the soft flesh of which must be peculiarly susceptible to attack, but in one small garden in Netherton it was noticeable in May Queens and Epicures, though not to a great extent. All those were slightly touched last year, but with the spread of the disease the cottagers have decided to give the plots a rest in the future from potatoes. The potatoes were all grown from new Scotch seed.

" A visit was afterwards paid to the well-kept farm of Mr. Thomas Woodcock, of Moss End, where we were shown more evidence of the scab in a field of Up-to-Dates.

" On the return journey a call was made at Mr. John Pimbley's, Kensington Farm, Maghull, where traces of the scab were shown us in a big ten-acre field which had recently been cleared to make room for Brussels Sprouts. Mr. Pimbley stated that he had found the disease in the Eclipse variety, as well as the Up-to-Dates, and pointed out that the worst place affected was a low part of the field, which was very wet and damp last year.

" Yesterday morning we called on Mr. John Tyrer, at his farm in Green Lane, Burscough, where in a field adjoining the Isolation Hospital, there were unmistakeable evidences of the scab. For a couple of years Mr. Tyrer has been fighting the monster, and last spring, on a recommendation from the Board of Agriculture, with whom he had been in communication on the subject, he applied a dressing of two hundred-weights of sulphur on a plot 280 yards by 10, planted with Up-to-Dates. The dressing, however, has proved ineffective, the disease being more rampant than ever.* He spread the sulphur broadcast on the drills before the setts were planted. As in other cases there is apparently nothing wrong with the tops, and, moreover, the crop is satisfactory. Several fine drills of globe mangolds which have grown alongside the affected tubers show no signs of the disease. Mr. Tyrer has two other fields in which he has found the scab, but with a view to getting rid of the disease he has one down with wheat, and he incidentally remarked that he would give it a seven years' rest from potatoes.† All his land is of a light black nature.

" In the course of the conversation Mr. Tyrer said that a large number of gardens in Ormskirk were full of the disease, and on the glebe land off Southport Road it was impossible to grow potatoes with any success.

" The disease is also prevalent in the cottage gardens at Westhead, and Hall Lane, Lathom, the crop being an absolute failure in the latter district."

Later, Mr. Gaut and Mr. Murray reported as follows :--

" From our recent inspection of the potato crops in the district comprising Ormskirk, Sefton, Netherton, and Maghull, it is evident that the disease exists there in its worst form and is spreading in an alarming degree. Although present to a certain extent on the farms of some large growers, it is in the garden or potato plot of the cottager that the disease assumes its most virulent form. In many of the latter the greater part of the crop has been utterly destroyed, and the remainder rendered unfit for domestic use.

" As regards the spread of the disease it is highly probable that any one or all of the following methods may come into operation: —(1) By the purchase and distribution of consignments of seed containing infected tubers ; (2) By the purchase and use on the land of certain kinds of town refuse, notably ash-pit refuse containing potato peelings ; (3) By means of returned barrels and hampers ; (4) By means of soil conveyed from field to field on working implements, etc."

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* A similar result has been reported from Burton-on-Trent, in cases where the Board advocated a dressing of sulphur.

† From information we now possess (see p. 295), a rest of at least *eight* years should be given to infected soil.

I have given in some detail the facts in the above case concerning one infected district in Lancashire, because such a state of affairs is probably to be found now in a number of places in England, Wales and Scotland, and because I wish to show the imminent danger which threatens potato growers—farmers, cottagers, allotment holders, and gardeners—in Kent and Surrey, and the South of England generally. Such an account as the above, but dealing with losses to the crop in Kent and Surrey—will in all probability have to be recorded, during the next ten or twenty years, in the pages of this *Journal*, unless more energetic action is taken. The disease is already dangerously close to us ; outbreaks (though fortunately isolated ones) have already been reported in the counties of Essex and Berkshire.

*Present distribution of the disease.*

In the last number of this *Journal* a list was given of the various counties, and of the different districts in each county as far as they were known, in which outbreaks of "wart disease" are known. The list of these counties was as follows : *England :* Cheshire, Nottinghamshire, Westmorland, Lancashire, Cumberland ; *Wales :* Merionethshire ; *Scotland :* Clackmannan, Perthshire, Stirlingshire.

The disease is now known from the following additional counties :—*England :* Shropshire (60 cases), Staffordshire (57 cases), Warwickshire (25 cases), Worcestershire (4 cases), Leicestershire (4 cases), Derbyshire (3 cases), Berkshire (1 case), Yorkshire, Essex. *Wales :* Flintshire (1 case), Breconshire (1 case), Glamorgan (1 case), Carnarvonshire. *Scotland :* Dumfriesshire (1 case), Fifeshire (a number of cases), Ayrshire (a few cases), Dumbartonshire (a few cases).

In most of the above cases the information has been derived from accounts published by the Board of Agriculture. I have been able to gather from other sources a certain amount of information with respect to some counties—as follows :—

*Yorkshire.* Mr. A. Gaut has stated that he has visited some of the gardens in Mortomley, and found the potato crop in places infested with "wart disease."

*Lancashire.* Some details as regards the present state of affairs in the Ormskirk district have already been given above (p. 298). Mr. A. Gaut has stated that when visiting some of the very badly infested districts in Lancashire, he found the crops of some of the varieties of potato so badly infested with "wart disease" that, approximately, scarcely 20 per cent. of the total were fit for use. Another account states :—"'Wart disease' has broken out amongst the extensive West Lancashire potato fields, and has caused something like panic amongst farmers in the district. The disease exists in its worst form, and is spreading in an alarming degree. On many farms the greater part of the crop has been utterly destroyed. The disease is rampant at Maghull, Burscough, Netherton, Sefton West, Head Latham, and other districts."

*Shropshire.* Prof. G. T. Malthouse writes :—"About seventy cases are now known in Shropshire, and the majority of these are on light soils, particularly the 'heath' soils, such as those round Hodnet, Stanton, Prees and Peplow."

At a discussion of the Shropshire Chamber of Agriculture at Shrewsbury on December 18th, 1909, on "wart disease" in Potatoes, Professor Malthouse said the disease was so prevalent in some parts of Shropshire that it was very desirable that agriculturists, and indeed everyone, should realise the seriousness of the outbreak. True, it did not as yet exist to any great extent in the fields, but its presence in cottage gardens and allotments adjacent to farms rendered it a constant menace to the well-being of the potato crop. Cultivation of the potato in cottage gardens would become impossible unless steps were taken to stamp out an outbreak whenever it occurred. Professor Foulkes, Principal of the Harper-Adams College, said inquiries were being made throughout the district as to the prevalence of the disease, and the Chamber would be surprised to learn from a return sent to him by the Board of Agriculture that in the last summer 568 cases were reported from Shropshire and Staffordshire alone. He thought that showed how widespread was the disease, and how important it was to pay attention to remedies and means of encouraging the cottager to take measures, which at present he was very disinclined to do. In cases where the disease existed they would be running a very grave risk of introducing it to the farm if they allowed the cottager to use his own ground and to plant it with his own seed.

*Warwickshire.* The following account refers to outbreaks discovered in September, 1908: "The farmers and allotment holders and cottagers in the potato-growing districts in the immediate neighbourhood of Birmingham are suffering from a disease, *viz.*, 'wart disease,' which is causing sad havoc among the crops. A large portion of the potato crop which supplies the Birmingham area comes from the Perry Barr side of the town, the potato-growing district extending right away up to Sutton Coldfield. The cottagers dotted here and there about the farmlands have suffered considerably from the disease, the crops in some of their gardens and allotments being almost entirely destroyed.

*Staffordshire.* In a letter published in the local press in October, 1909, Mr. H. F. M. Buchanan, of Hales, near Market Drayton, writes:—" 'Wart disease' in potatoes, by all accounts, *is spreading from the gardens to the fields, and if not checked will make potato-growing impossible over large areas of the country.* Most of the cottage gardens on my estate are infected badly." In a communication to me Mr. Buchanan writes:—" Unless something drastic is done by the Government this disease will devastate our gardens, and from our gardens will devastate large areas of the country in which potatoes are grown."

*Fifeshire.* Mr. Thomas Young has reported an outbreak in two gardens in Cupar.

*Ireland.*—The prompt and scientific manner in which the first outbreaks in Ireland have been dealt with form an object-lesson of the practical value of a properly-organised State Agricultural Department. The Irish Board have the great advantage of receiving directly competent scientific advice; Ireland has also the services of recently appointed "seed inspectors" one of whose duties it is to be constantly on the watch for cases of importation of the disease,—whereas the English Board take no such precautions. The first announcement of the presence of "Black Scab" in Ireland was made in the House of Commons on November 6th, 1908, when the Right Hon. T. W. Russell, Vice-President of the Department for Ireland made the following statement:— " 'Black Scab' has been reported from two centres in

County Down. The inspector has visited the district, and declared the disease in both cases to be 'Black Scab.' In one case the potatoes had been dug, and the inspector had ordered the immediate destruction of a portion of the crop, and his order had been complied with. In the other case the crop was still in the ground, and notice had been served that the potatoes were to be left in the ground pending further instructions.* Recognising it to be a calamity to Ireland, the Department would leave nothing undone to stop the progress of the disease." At the meeting of the "Council of Agriculture," held soon afterwards in Dublin, the Right Hon. T. W. Russell gave the following additional information :†—"The Department have made very full investigations, and with the exception of three spots in the East of County Down no trace of this disease can be found. With this exception it may confidently be asserted that Ireland is free from the disease. The outbreak in County Down is fortunately not serious, being confined in one case to gardens attached to a Coastguard station, and in the others to two fields and to one variety of potato. Measures were immediately taken to isolate these districts, and to deal effectively with the crops, so as to prevent the spread of the disease. There is in the North of Ireland an important seed trade with Malta at this time of the year. The Maltese authorities, on account of the existence of 'Black Scab' in Great Britain, have prohibited the importation of seed potatoes into Malta from that country. The efforts of the [Irish] Department, and the guarantee of this country [Ireland] being practically free from the disease, have secured for Ireland freedom to export seed potatoes to Malta under Departmental supervision, which has been freely granted to shippers. For the future it behoves everyone to do his utmost to see that this disease does not spread in Ireland. Suspected cases should be at once reported to the Department, *so that should the disease appear in any new district, it may be at once exterminated.* Above all, care should be taken this year in the importation of 'seed' from Great

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* The issuing of the "Black Scab in Potatoes (Ireland) Order, 1908," on October 1st, 1908, by the Irish Department of Agriculture, conferred the necessary powers on the Inspector. The English Board, although possessed of full legal powers under the "Destructive Insects and Pests Act" of July, 1907, has issued no such Order.

† See *Irish Farming World*, November 27th, 1908.

Britain.* The Department has been asked to prohibit entirely the importation of seed potatoes. This, however, is a measure which should be undertaken only as a last resort ; *but should the necessity arise the Department will not shrink from this duty.*" In a letter which I received in December, 1908, from the Secretary of the Department of Agriculture for Ireland, the following information is given :—" I have to state that only three cases of 'Black Scab' in potatoes have been discovered in Ireland. All the diseased tubers have been destroyed in compliance with a notice served by the Department under the 'Black Scab' in Potatoes (Ireland) Order, 1908." I have to add that no compensation has been paid to the owners of the potatoes so destroyed.

In January, 1910, in answer to an inquiry as to whether any further outbreaks had occurred in Ireland, I obtained the following information from the same source : " In one of the districts in County Down in which the disease appeared in 1908, some few potatoes on three holdings were found to be affected with this disease. All the diseased potatoes were destroyed without compensation. Further, the Department will not grant permission for planting potatoes this year on the lands in which the affected crops were grown last season. I have to add that the lands on which the disease was found to exist in 1908 were not planted with potatoes in 1909."

I would strongly advise Potato Growers' Associations and Farmers' Clubs in potato-growing districts in England and Scotland to impress upon the Board of Agriculture the necessity of their taking legislative steps, before it is too late, to prevent this new disease sweeping through the country. English growers should note carefully what is happening in Scotland. When during 1908 the fact was published that outbreaks of " wart disease" had occurred in certain counties in Scotland, the

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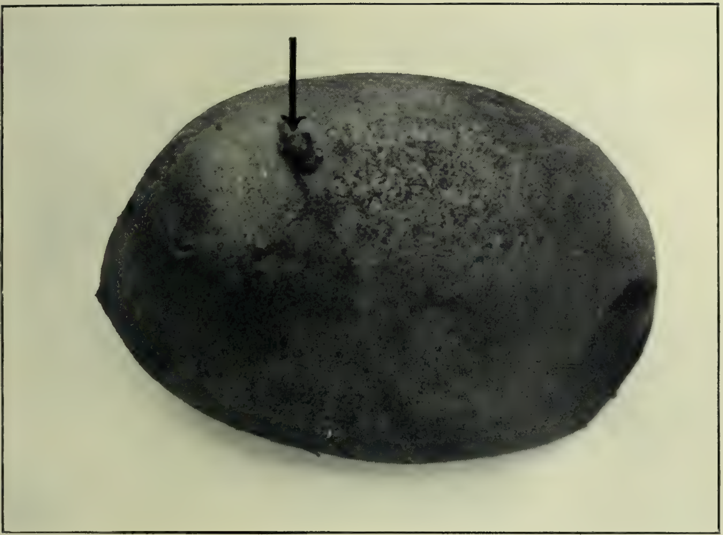
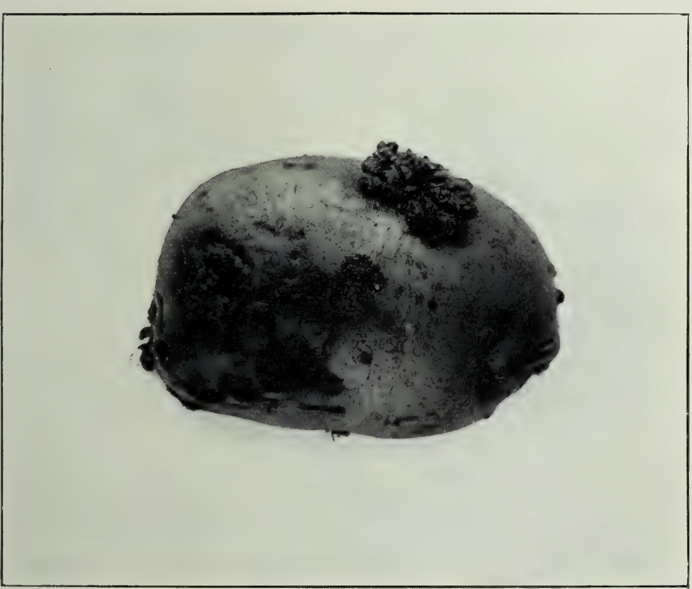
* Professor T. Johnson (Sci. Proc. Royal Dublin Soc., vol. xii., p. 136, 1909) has made the following very important statement : " It is this last-mentioned mode of propagation, *i.e.*, *by 'warty' seed-tubers*, which, I think, accounts for the outbreak of 'wart disease' in Co. Down, Kilkeel, one of the disease spots, is an important fishing village on the coast, with considerable intercourse with the English and Scotch coasts, from which slightly diseased tubers could easily be imported, unnoticed by the buyer." If further investigations show that the importation of disease here suggested has actually taken place, the Irish Department of Agriculture will be under the necessity—having regard to the enormous importance of the health of the potato crop to Ireland, —of prohibiting entirely the importation of potatoes from Great Britain.



[*W. H. Hammond, photo.*

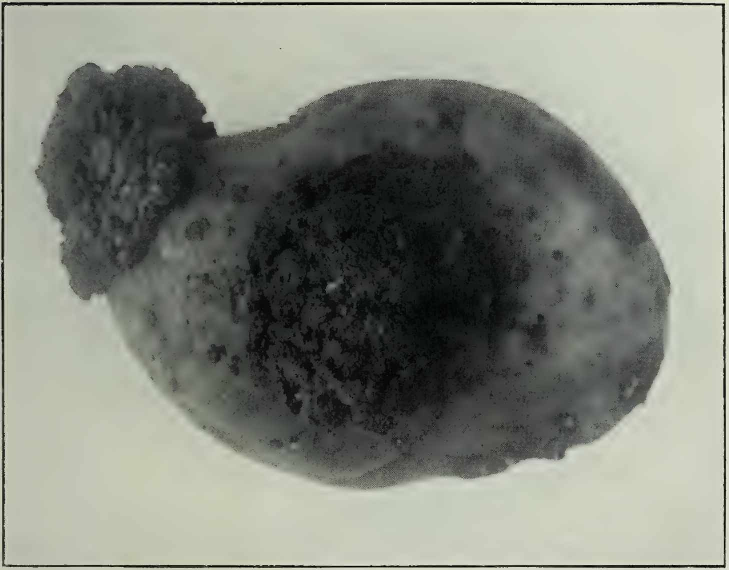
A potato very slightly attacked by " wart disease,"—one small " wart " being present at one of the " eyes." *The use of such tubers as " seed " is spreading this new and most destructive disease through Great Britain.*



[*W. H. Hammond, photo.*

A potato slightly attacked by " wart-disease "; several small " warts " have been produced.

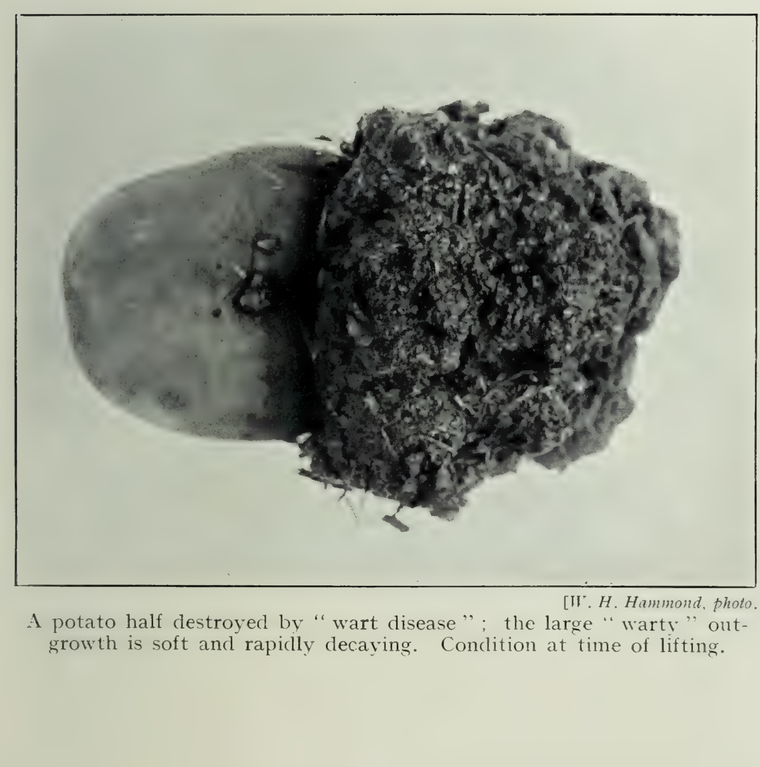
PLATE 33.



[*W. H. Hammond, photo.*

A potato severely attacked by "wart disease"; two large "warty" outgrowths, and several smaller ones, have been produced.

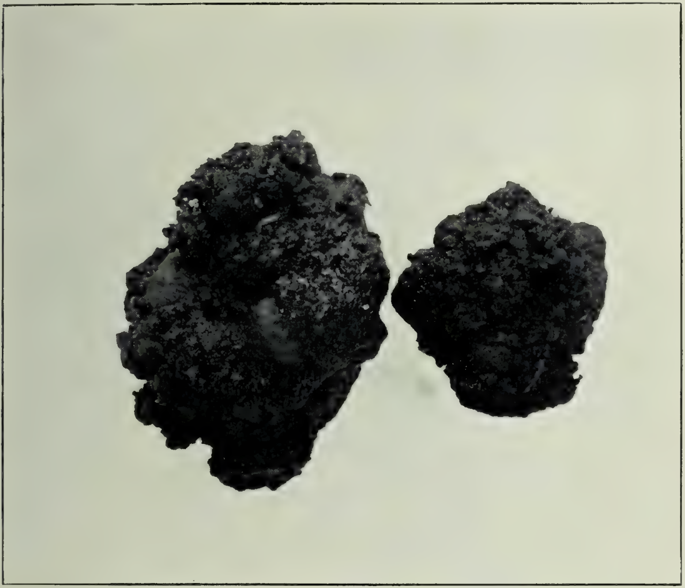
PLATE 34.



[*W. H. Hammond, photo.*

A potato half destroyed by "wart disease"; the large "warty" outgrowth is soft and rapidly decaying. Condition at time of lifting.

PLATE 35.



[*W. H. Hammond, photo.*

Potatoes entirely destroyed by "wart disease"; the original smooth skin of the tuber can be seen in two places in the example to the left.

fear that this would injure the sale of Scotch "seed," led a section of agriculturists in Scotland* to attempt to make light of the matter. This section professed to believe that "the disease had not affected the field crops," but was one confined to gardens or to land where potatoes were grown continuously. It will be well to repeat here part of the letter addressed to the editor, which I sent to the *North British Agriculturist*:†—"The facts are as follows: This disease is not one which can be regarded (as you suggest) as 'mainly confined to gardens dressed with ashpit manure, and cropped with potatoes year after year.' The Irish Department of Agriculture—see their excellent Leaflet No. 91—will not let the Irish potato growers put faith in such an unscientific point of view as this; and if Scotch growers take this view now, they will find themselves woefully deceived in a few years' time. Numerous cases are already on record where the soil of fields of several acres in extent has become infested with the germs of "wart disease," with the result that the crop has not been worth harvesting, as every tuber has become affected. The continued spread of this disease in England during the past ten years, and the very serious losses that have already resulted, are points which are fully dealt with in the *Journal* of the South-Eastern Agricultural College, vol. xvii. On 3rd October last the Board stated that 244 outbreaks were known in England and Scotland; it is probable, however, that three or four times as many have occurred.

"In the able article on 'wart disease' published in August, 1907, by Dr. A. W. Borthwick in the 'Notes' from the Royal Botanic Garden, Edinburgh, the following sentences occurred: 'Preventive measures to be effective must be adopted by all growers of potatoes; individual or isolated action, although productive of some good, may be of no avail in a case of this kind, nor in the case of any other threatened epidemic. The health of the potato crop in Scotland is of extreme importance, not only to the country itself, but to other countries to which "seed" potatoes are sent; hence no effort should be spared in order to stamp out this new and recently introduced enemy to such an important food-crop.' It is a pity that agricultural journals in Scotland neglect such warnings of scientific investigators.

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* See *The North British Agriculturist*, November, 1908.

† Nov. 19, 1908.

"You refer to the 'microscopically few cases' which have occurred in Scotland. I would point out that only a few years ago there were 'microscopically few cases' of the American Gooseberry-mildew in England; now there is scarcely a fruit-growing county that is not overrun with this pest. If nothing is done now, the 'wart disease' will spread none the less surely, although, probably, not so quickly, through England and Scotland."

Fortunately a more progressive section of agriculturists in Scotland, who realise the danger of the continued spread of "wart disease," are now taking the matter up. At the meeting of the Scottish Chamber of Agriculture held in March, 1909, Mr. M. G. Wallace, in bringing forward a motion in favour of the creation of a separate Department of Agriculture for Scotland, commended the prompt measures taken in Ireland, and stated that "he happened to be in the Irish Department Offices on the very morning when the news of the outbreak was received from Co. Down. An inspector was at once sent, the affected potatoes were at once destroyed, compensation being paid,* and the land on which they were grown limed and sown out. The result of that prompt procedure was that in some of the best colonial and foreign markets, while there was an embargo on Scottish and English potatoes, there was none on Irish."†

In the last number of this *Journal* information was given (as far as it was possible to obtain it) with regard to the distribution of the disease. Information obtained from a number of reliable sources makes it quite certain that the disease is still spreading year by year.

No work is more urgently required than that of the official investigation and mapping out of the areas in England and Scotland at present believed to be affected with this disease. The speedy publication of this information would enable farmers either to avoid these districts when purchasing "seed," or to scrutinise carefully any "seed" obtained from such districts; it would also help to make the growers in the affected areas do all they could to stamp out the disease, so that their district could be declared free.

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* It appears that this is an error, and that no compensation was paid.

† *North British Agriculturist*, March 4th, 1909.

In the Report of the Plant Diseases and Insect Pests Committee* of the Central and Associated Chambers of Agriculture, adopted by the Council in December, 1908, the paragraph occurs :—" The Committee are decidedly of opinion that the Board of Agriculture should issue a map showing where 'wart disease' exists in Great Britain at the present time." Again, in the Report from the same Committee adopted by the Council in September, 1909, we read: " The Committee expressed (in December, 1908) the desirability of the Board of Agriculture issuing a map showing where 'wart disease' existed in Great Britain at that time. They have now to report with much regret that no map has been issued, and they are unable to learn that any serious steps are being taken to eradicate the disease, or even to prevent it spreading."

### *Prohibition of Exportation of Potatoes through prevalence of "wart disease" in Great Britain.*

During 1908 and 1909 I have been consulted by agriculturists in official positions in our Colonies, as well as in other foreign countries, on the subject of "wart disease," information being asked as to whether the disease is a dangerous one from the economic standpoint, and also whether it is increasing in Great Britain. I have felt bound to reply that there is now a consensus of opinion that this disease is capable of causing wholesale destruction of the potato crop, and that it is extremely difficult to render soil healthy again when once it has become infected; further, that the disease is on the increase and that, in my opinion, all foreign countries which are desirous of keeping out this pest should refuse at their ports all potatoes grown in Great Britain, unless the Board of Agriculture can certify that the consignment is free from "wart disease."

A more scientific and—in the long run—economical course would be for the Board of Agriculture to deal with this disease as certain infectious animal diseases are dealt with, *i.e.*, by declaring certain districts "infected" and then prohibiting in those areas the growth of potatoes until the outbreak has been stamped out. In this way a general guarantee of the health of all exported potatoes would be officially given. No doubt this would entail considerable hardships on a large number of persons in the various districts already infected, but it must be borne in mind, firstly, that it would be more economical in the long run to compensate, or partly compensate, such growers for losses incurred in the work of exterminating the pest, than to continue to allow this disease to spread from county to county, causing grave losses to the cottager and allotment holder, and ultimately to the farmer.

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* The Committee consists of Laurence Hardy, Esq., M.P. (Chairman), J. W. Dennis, H. C. Gardner, W. W. Glenny, W. G. Lobjoit, Prof. J. Percival, S. U. Pickering, Prof. M. C. Potter, E. S. Salmon and B. Stanier, M.P.

The list of countries in which legislation, prohibiting or restricting the importation of potatoes from Great Britain, has already been put into force is as follows :—

*Ireland.*—The "Black Scab" in Potatoes (Ireland) Order of 1908 (issued on October 1st, 1908) prohibits under heavy penalty the landing in Ireland of any diseased tubers. The Irish Department suggests that seed potatoes should not be purchased from Great Britain unless the vendors are prepared to give a guarantee that "Black Scab" ("wart disease") was not known to exist on the farms on which the potatoes were grown.

*Malta.*—A Government Notice dated January 20th, 1909, prohibits the importation of potatoes exported from England or Scotland, unless accompanied by the following documents, viz. (1) A Statutory Declaration by the shipper, naming the place of origin, and stating that such potatoes were not grown on land infected with "Black Scab" ("wart disease"); (2) a certificate from an officer of the Board of Agriculture stating that the locality in which the potatoes were grown is free from that disease.

*Natal.*—A Government Notice, which came into force on April 1st, 1909, orders that consignments of potatoes showing any trace of "Black Scab" ("wart disease"), or certain other specified diseases, will not be permitted to enter Natal. It is further stated that agents importing potatoes for the inland Colonies are warned that consignments railed from Durban and subsequently condemned across the border will not be allowed to re-enter the Colony, except for shipment abroad.

*Jersey.*—The Jersey States Committee of Agriculture have issued an Order prohibiting absolutely the importation of potatoes from the United Kingdom in view of the prevalence of "Black Scab" ("wart disease") in England.

*Guernsey.*—The Royal Court of Guernsey has issued a similar Order to the above. A Guernsey correspondent in the horticultural press[*] writes: "Many of the Channel Islands potato farmers send their sets to Lincolnshire and the Fen district to be grown for a season. These cannot now be re-imported."

*Transvaal.*—An Order proclaims that after August 1st, 1909, all potatoes will be officially examined; any consignment found to be infected with "Black Scab" ("wart disease") will not be re-sorted, but will be destroyed immediately on arrival.

*Orange River Free State* and *Nyassaland.*—The importation of potatoes from Great Britain into these countries is prohibited except under a licence.

A fresh source of danger is now arising, viz., the danger of the importation of "wart disease" into Great Britain by means of diseased potatoes exported from other countries. As far as is known there is at present far more "wart disease" in England than in any other country; the disease, however, has been detected during the past year or two in several foreign countries. During 1908 Spieckermann,[†] Schneider,[‡] and Jösting[||] reported the occurrence of "wart disease" in parts of Germany (Arnsberg in Westphalia; Cronenberg (Düsseldorf); Kahnerberg (Elberfeld). Although not previously recorded, the disease was found on investigation to be of some years' standing in these localities; it has steadily increased in virulence until by 1908, on ground where potatoes have been grown year after year, the damage inflicted was so serious that scarcely any healthy tubers were grown. The variety "Magnum Bonum" proved specially susceptible. Prof. T. Johnson has written: "The 'wart disease' ('Black Scab') is now known from various districts in Westphalia and the Rhine Provinces. Germany would make a serious mistake if it treated the outbreak of this disease with indifference. This, I know, its mycologists will not do."

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[*] *The Fruit-grower*, September 16th, 1909.

[†] In *Prak. Blätter für Pflanzenbau u. Pflanzenschutz*, VI., 1908 (figures).

[‡] In *Deutsche Landwirthschaftliche Presse*, XXXV., p. 832, 1908 (figures).

[||] *L.c.* p. 883.

In October, 1909, a Bulletin, by H. T. Güssow, was sent out from the Department of Agriculture, Central Experimental Farm, Ottawa, Canada, recording the discovery of "Black Scab" in potatoes sent to the Department from a locality in Newfoundland. This Bulletin states; "there can be no doubt that the disease was introduced into Newfoundland by means of diseased seed tubers, imported from infected areas." In this Bulletin it is stated further that "wart disease" has appeared in Scandinavia, France and Italy.

Aware that there was no legislation directed towards preventing the importation of the disease, the College called public attention to the matter. Through the help of Mr. L. Hardy, M.P., the following question was put in the House of Commons on November 12th, 1908: "Whether the Board are aware that 'Black Scab' has broken out in Germany; and whether they intend to take steps to prevent the importation of diseased potatoes into Great Britain by issuing an order in similar terms to the Irish Order of October 1st, which prohibits the importation of diseased potatoes into Ireland." The answer given was to the effect that the Board "did not propose to adopt, at any rate at present, the suggestion."

Finally, let us see what are the latest measures proposed by the Board as suitable for dealing with the present disease. The following official announcement, signed by the Secretary to the Board, has just been issued :—

"For some time past the Board of Agriculture has been investigating the nature of 'wart disease,' which affects potatoes. The Board has been subjected to criticism for not adopting the method decided upon by the Irish Department of Agriculture. In Ireland where there were one or two isolated instances of the disease, the potatoes affected were all destroyed, and the owner of the land on which they were grown was forbidden to again grow potatoes upon it. It was felt by the Board of Agriculture that this drastic method of dealing with the disease was quite inapplicable to England where there are hundreds, if not thousands, of places affected in different parts of the country. The Board has therefore adopted another method, the results of which are set out in the following circular letter addressed to occupiers of premises affected with 'wart disease' :—

"I am directed by the Board of Agriculture to inform you that they have for some time past been engaged in investigating the nature of what is known as wart disease, black scab, cauliflower disease, etc., which was present in your potatoes this year, and they have endeavoured to discover some remedy. As you are no doubt anxious to avoid a repetition of the disease among your potatoes, I am directed to send you the following information : Experiments on wart disease were carried out on behalf of the Board by the staff of the Education Committee of the Lancashire County Council, of the Harper Adams Agricultural College, Shropshire, and of the Holmes Chapel Agricultural College, Cheshire. The experiments were made on infected land at five places. In each experiment tests were made (1) on the effect of possible remedies ; (2) on a number of varieties of potato, in order to ascertain whether they did or did not contract disease. Three possible remedies—sulphur, quicklime, and soot—were applied, but in every case failed. No one of them prevented the crop from being badly diseased. Sulphur was also tried on many allotments and gardens, but in nearly every case without success. It is possible that in another season better results might be obtained, but it is clear from the experience of 1909 that when ground is infected the use of sulphur, lime or soot cannot be relied upon to save potatoes from wart disease.

"The trials with varieties were more successful. The following sorts were tested and found *to be attacked by wart disease :* Up-to-Date, Northern Star, King Edward VII., Eldorado, Royal Kidney, British Queen, Talisman, Epicure, Sharpe's Express, May Queen, Ninetyfold. All were badly affected, though some were worse than others. The following sorts were tested and found to be *not attacked by wart disease* : Langworthy, What's Wanted, Golden Wonder, Sutton's Abundance, Findlay's Conquest, and (?) Snowdrop. Snowdrop was not grown at all the centres. It was found that the stock of this potato was not true, a kidney form (probably true stock) was quite free from disease, but an oval form was diseased. In many cases information has reached the Board that Snowdrop is free from wart disease, and in other cases disease has been reported. This variety should, therefore, be regarded with suspicion. True stocks are probably safe, but there would seem to be some difficulty in securing Snowdrop potatoes true to type.

" Traces of disease were found on one or two plants of Abundance and Conquest at one centre, but it is possible that the affected plants were rogues, for not a trace of disease was found on these varieties at other centres, although growing on soil on which almost every plant of Up-to-Date was diseased. No trace of disease was seen on Langworthy, What's Wanted and Golden Wonder. These three sorts all belong to a type of potato formerly well known as Clarke's Maincrop. The first two are much alike, the third is a brown-skinned potato of good quality, grown in some parts of Scotland, but not yet common.

" Of the various sorts which were not affected by disease, Conquest and Snowdrop are early and the others late in ripening. Growers who have infected soil should procure seed of one of the sorts that do not contract disease. Conquest would probably prove best for early use and Langworthy as a late or field potato.

" Growers, where land is infected, should avoid not only Up-to-Date, but all varieties of the same class, that is, varieties having the same kind of haulm and flower, such as Factor, Table Talk, Dalhousie, Highlander, Mayfield Blossom, Duchess of Cornwall, Hero ; they should similarly avoid potatoes of the same type as British Queen, Royal Kidney, or any other of the affected varieties.

" The importance of following this advice cannot be too strongly insisted upon. Wart disease is not very widely spread in Great Britain, but it is very bad in allotments and gardens in most places where it has appeared. No ordinary crop is liable to be attacked by it except the potato, and if everyone plants either disease-resisting varieties of the potato, or some other crop on his holding, it is likely that the disease will die a natural death and disappear. But it must be borne in mind that to secure this no potatoes that are liable to attack should be planted in infected ground for many years."

Here, for the first time, we have the definite announcement made that *the Board will not attempt to stamp out "Black Scab" in Great Britain in the way that the Irish Department of Agriculture are stamping it out in Ireland.* The reason given is that there are " hundreds, if not thousands of places, affected in Great Britain." Yet in the same anouncement we read that the disease " is not very widely spread in Great Britain." Of course, owing to the start the disease has now obtained, the work of eradication would now be both arduous and expensive (though not, I believe, impossible). It is certain, however, that the longer the work is put off the greater will be the hardship which will ultimately have to be borne by the grower in the infected districts.

As for the new measures now proposed by the English Board, they are, in my opinion, quite insufficient to meet the case. For the past seven years the Board have been officially recommending treatment of infected soil with sulphur and lime, but now, at the end of 1909, they announce that " it is clear that when ground is infected the use of sulphur, lime or soot cannot be relied upon to save potatoes from 'wart disease.'"

Their new measures are framed on the belief that certain varieties of potatoes are resistant to the present disease, and they recommend that growers with infected land should grow only these varieties. Now in the first place the alleged disease-resistant nature of the varieties *requires to be scientifically tested for several seasons in different soils* (*which has not been done*) before it can be put forward as a means of dealing with a most destructive disease of a plant of such enormous importance as the potato. Then comes the question of the suitability of such varieties for cultivation ; as a matter of fact the varieties named are not suitable for general cultivation. In a Leaflet issued in 1908 by the Harper-Adams Agricultural College we read : " Of the varieties stated to be immune Snowdrop is not suited to all districts, and suffers badly from potato ' blight.' Langworthy and Maincrop are both of good quality, but not heavy croppers." I am informed by experienced potato growers that of all the "resistant" varieties mentioned, only "Golden Wonder" can be considered a really good, serviceable variety, and that this cannot be grown except in certain soils. It will be noticed that *all the* *best varieties of potatoes—i.e.,* all those most profitable to grow *—are excluded as susceptible.*

To suppose that the majority of growers will voluntarily plant these alleged " resistant " varieties which are poor croppers in order to stamp out the disease, rather than continue to risk outbreaks by planting at least some of the susceptible varieties ordinarily grown, is surely a mistake.

The Pests Committee of the Central Chamber of Agriculture, at a meeting held on December 16th last, sent a communication to the Secretary of the Board, in which the following occurs :—" The Committee cannot agree that it is advisable to merely suggest to growers that they should only plant what are termed disease-resisting varieties of potatoes, for in the first place, most of these so-called ' disease-resisters ' are very small croppers, and your advice, if followed, would cause dissatisfaction ; and, secondly, the power of resisting disease, as well as the efficacy of suggested remedies, can only be established by careful experiments, continued throughout several seasons, by competent scientific workers. In this connection, the Committee wish to earnestly recall your attention to the last paragraph of their report, dated December 1st, 1908, in which they suggested that the Board should appoint an Advisory Committee of experts to assist the Board in dealing with Plant Diseases generally, as recommended by the Departmental Committee on the Fruit Industry."*

*Postscript.*

Since the above was written some further information as to the distribution of " wart disease " in Great Britain has been published by the Board of Agriculture,† as follows :—

" During the autumn of 1909 the Board were engaged on an enquiry into the distribution of ' wart disease ' (' Black Scab ') in Great Britain. Five Inspectors were instructed to visit suspected districts, and to urge potato growers to report cases of disease.

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* A similar communication had been sent to the Board previously from the Council of the National Fruit-growers' Federation.

† *Journal of the Board of Agriculture* for February, 1909.

A large number of letters were received from occupiers and others reporting the presence of the disease.

" From an examination of all the available information it would appear that ' wart disease ' is almost entirely confined to an area including Lancashire (south of the Ribble), Cheshire, Shropshire (north of Shrewsbury), Staffordshire, and those parishes in Warwickshire and Worcestershire which immediately adjoin Birmingham. Within this area most parishes contain one or more allotments or gardens in which diseased potatoes were found, though in only a few cases were the field crops affected. ' Wart disease ' has spread beyond this area in patches among the parishes that lie round it. Thus, a few cases have appeared in Warwickshire as far south as Kenilworth and so far east as Rugby ; two parishes in Leicestershire are affected ; a few cases occur in Derbyshire and West Nottinghamshire in the neighbourhood of Mansfield ; and a few parishes in the West Riding of Yorkshire, on the borders of Derbyshire and Cheshire have been attacked. Westwards of the affected area the disease has spread in patches into Wales, appearing in the Counties of Brecon, Cardigan, Carmarthen, Carnarvon, Denbigh, Flint, Glamorgan, and Merioneth.

" The Board's Inspectors have examined a large number of parishes in Gloucester, Warwick, Leicester, Nottingham, Lincoln, and the West Riding of York, adjoining the infected area, without finding any trace of the disease.

" ' Wart disease ' has also spread northward beyond the infected area in patches. Cases have been found in Lancashire (north of the Ribble), in Cumberland, east Dumfriesshire, in north-west Ayrshire, and in two small areas, one including Clackmannan, south-west Perth, east Stirling, and south-west Fife, and the other, central Fife and Kinross. It appeared also in the neighbourhood of Edinburgh. In nearly every case the disease is confined to allotments and gardens, and the field crops are untouched.

" An examination of the map of Great Britain shows that outside the affected area and the isolated patches there are large and important districts under potatoes where the disease is unknown. Growers outside the area would be well advised to procure their seed from unaffected districts, but those inside can with safety buy potatoes locally or from other parts of the area, provided that they ascertain that the potatoes were grown on a farm where the disease does not exist.*

"Great care must be taken not to apply manure made from diseased potatoes to arable land. If the manure is contaminated disease will appear, no matter how carefully seed may be chosen. It is probable that disease introduced into the soil by manure may infect potatoes planted several years after the manure has been applied."

Such information will have to be further extended and of a more detailed nature before the farmer who is anxious to avoid purchasing diseased "seed" and so introducing the disease on to his land can benefit by it. The farmer will necessarily be exposed to grave risk *until the sale of "seed" from all infected areas is prohibited by law.*

It must not be assumed from the above that "wart disease" is likely to be confined only to allotments and gardens,† and we find in the Board's own (revised) Leaflet No. 105 the statement: "When this disease appears it may, if neglected, spread over a farm and render the soil useless for potato-growing in the course of a few years." *The fact that farmlands generally are in great danger of becoming infected is the main point to be insisted upon.*

If those interested in agriculture are not content to see this new disease spread through the whole country, now is the moment to unite and take concerted action. The last chance of safeguarding for the future the health of the potato crop generally is rapidly disappearing.

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* A mere statement by the grower or salesman that the seed potatoes on sale come from a district where the disease does not exist is quite insufficient in the case of so serious a disease (which, moreover, is new and little known). If such measures are considered by the Board sufficient to stop the spread of "wart disease," why is it that legal restrictions have been put into force (under the American Gooseberry Mildew Order) affecting the sale of gooseberry bushes? Also, of what use is it to give the advice,—"growers outside the area would be well advised to procure their seed from unaffected districts," when no detailed information as to where the infected districts are, is published by the Board?

† This false impression has, unfortunately, already been gathered by agriculturists in Scotland from similar statements (see p. 307).

# **The** *Sclerotinia* (*Botrytis*) **disease of the Gooseberry, or "Die-back."**

(Plates 36 to 43.)

The *Sclerotinia* disease of the Gooseberry—or "die-back," as it is called in some districts in Kent—has received but little attention up to the present in this country. In the present article some fresh facts are given as to the life-history of the fungus, and certain measures described, which in practice, have been found successful in dealing with the disease.

The disease is widespread in England, and is liable to occur wherever gooseberries are grown, whether in plantations or in the private garden. It attacks bushes growing on stiffish clay as well as bushes growing on light stony or gravelly soils. I have seen it doing considerable mischief in Kent (especially round Sittingbourne and Faversham, and in the Sandwich district*), Surrey and Sussex, and specimens have been sent to me from Hampshire, Herefordshire, Worcestershire, Gloucestershire, Somersetshire, Devonshire, Essex, Berkshire and Middlesex. Not a season passes without a number of examples being sent in to Wye College, and reports from various parts of the country have been received of young plantations—very probably planted up with diseased cuttings taken from affected bushes—having suffered severely from the outset. Within the last few years bushes killed by *Sclerotinia* have been sent in by growers in the belief that the American Gooseberry Mildew had invaded their plantations and done this mischief. As a matter of fact, as is shown by the illustrations given below, there is not the slightest resemblance between these two diseases.

## *Description of the Disease.*

The gooseberry bush may be attacked in four distinct places, *viz.*, the main stem and base of the branches, the young wood of the current year, the leaf, or the berry. First, as regards a bush attacked in the main stem. The spawn (*mycelium*) of the fungus penetrates into the tissues of the stem (permeating the cortex and bast) and at the end of a season's growth causes the bark to crack and peel off, often in large pieces. The part of the stem first attacked is usually that portion situated at the ground level or a little above it; eventually the spawn of the fungus "rings" the stem at this place and the whole bush is killed. Before this occurs, however,—and death does not occur as a rule in the case of a well-grown bush until after several seasons from the time it was first attacked—the spawn of the fungus spreads upwards in the stem to the base of the branches. Here it frequently attacks some of the branches so severely that they die. *The presence of dead branches in a few bushes, or the death of half the bush, is a characteristic sign of the first appearance of the Sclerotinia disease in a plantation.* And, as is noted below, it is at this time that steps should be taken to stop the disease.

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* The variety of Gooseberry known as "Sandwich Yellow" or "Cousin's Seedling" has proved very susceptible in this district.

Renewed growth in the spawn of the fungus in the stem takes place every spring, and it is at this time that the manner in which the fungus exists and spreads can be most easily seen. If a diseased stem is examined during a warm and damp spell of weather in the spring, the appearance shown in the photograph at Plate 36 will be observed. The bark will be found to be peeling or cracking off, while, as may be seen in the photograph, greyish fluffy patches of a "mould" have appeared at the edges of the peeling bark or in the fissures where the bark is cracked. If there is a dead branch on the bush, then, as a rule, compact greyish tufts or little cushions —which soon develop in suitable weather into fluffy patches such as are shown in Plate 36—will be found scattered here and there over its surface,—as shown at X in Plate 37. These tufts of the fungus occur both on the main branches nearly down to their base (Plate 37), and also, frequently, on the younger wood (Plate 38). If with the point of a knife a little of the fluffy growth shown in Plate 36, or of the more compact tufts shown at X in Plates 37 and 38, is taken, and placed in a drop of water under the microscope, the structure will be seen to be the same. In both cases the fructification shown in Fig. 1 will be seen. We see (to the left) a number of upright branches (*conidiophores*) rising from the spawn of the fungus which creeps horizontally; these upright branches are brown in colour, and bear side branches, which as well as the main branches give rise at the tip to a roundish head of very minute oval *spores* (*a*). A large number of these very minute *spores* (which measure about $10_{\mu} \times 5_{\mu}$*) are produced in each head. In the drawing to the right (Fig. 1) the tip of a main branch and of its side branch is shown more highly magnified; here most of the *spores* have fallen off, but some of the *spores* (*b*) can be seen attached to the little stalk (*sterigma*) (*c*) on which they are borne. It is these crowded upright branches, or *conidiophores*, densely packed side by side, and each bearing numerous heads of many thousands of *spores*, which give the tufts of the fungus its characteristic fluffy or minutely powdery appearance. Each *spore* of the fungus, it must be noted, is able, just like the

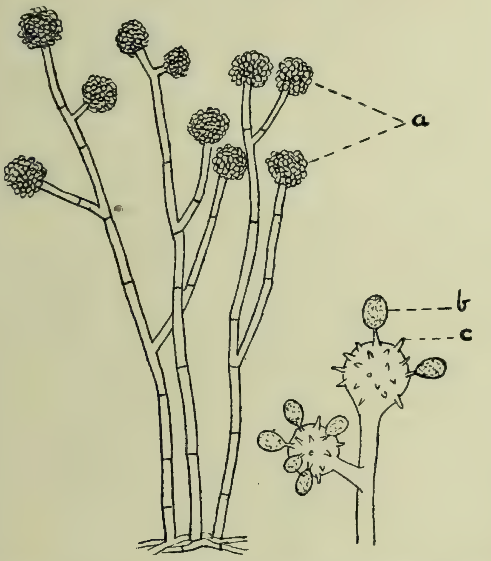

Fig. 1.—Fructification of *Botrytis; to left*, group of three branched *conidiophores* bearing heads of *spores* (*a*); *to right*, apex of a *conidiophore*, and of one of its side branches, showing the manner in which the *spores* (*b*) are borne on minute stalks or *sterigmata* (*c*). Highly magnified.

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* $\mu$ = One thousandth of a millimeter.

seed of higher plants, to give rise to another distinct individual of the same kind.

The fructification shown in Fig. 1 has long been known under the name of *Botrytis*. It has lately been discovered, however, that this is a stage of a fungus called *Sclerotinia*.* Turning to Plate 36 again, we should find if we looked carefully into the cracks of the bark where the *Botrytis* fructifications are appearing, that while some spring directly from the spawn of the fungus hidden in the tissues of the stem, *others arise from small, hard, blackish bodies, a few millimeters long and of irregular shape.* These little blackish bodies consist interiorly of a dense compact mass of thin-walled, colourless fungus tissue, and on the outside of a protective layer of dark-coloured thicker-walled cells. Such bodies are called *sclerotia ;* they are extremely resistant to climatic conditions such as frost, drought, etc., and serve to carry the fungus through all vicissitudes from one growing season to the next. In Plate 40 is given a micro-photograph of part of two *sclerotia* which have partly grown together ; one (to the left) has just commenced to grow again and to produce a tuft of *conidiophores*. In Plate 41 we have part of another *sclerotium* more highly magnified; here we can see the base of a *conidiophore* arising directly from the tissue of the *sclerotium*. *These sclerotia are able under certain conditions to give rise to another form of fructification, in which winter-spores* (*ascospores*) *are produced.* In this stage the fungus has been known under the name of *Sclerotinia*, while the name *Botrytis* has been applied to the stage (shown in Fig. 1) where summer-spores only are produced. It is probable that the *Sclerotinia* stage, with its winter-spores, only rarely occurs, and it is certain that the disease can be perpetuated from season to season in its absence by means of the *Botrytis* stage which spreads the disease during the growing season, and by the dormant mycelium in the stem or by the *sclerotia* on its surface, which enables the fungus to hibernate during severe winters. I have often seen, as early as February, numerous powdery tufts of *conidiophores* on the surface of an affected stem ; it is probable that such survive all through mild

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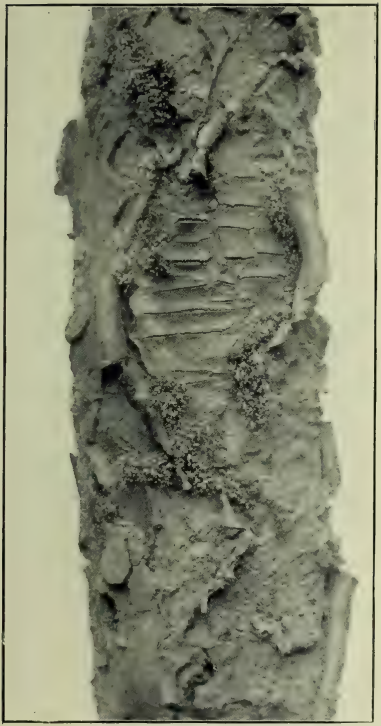
* It is probable that the species which attacks the gooseberry is *S. Fuckeliana*, the conidial stage of which has been called *Botrytis cinerea*. *S. Fuckeliana* is known to be the cause of disease of a number of cultivated plants.

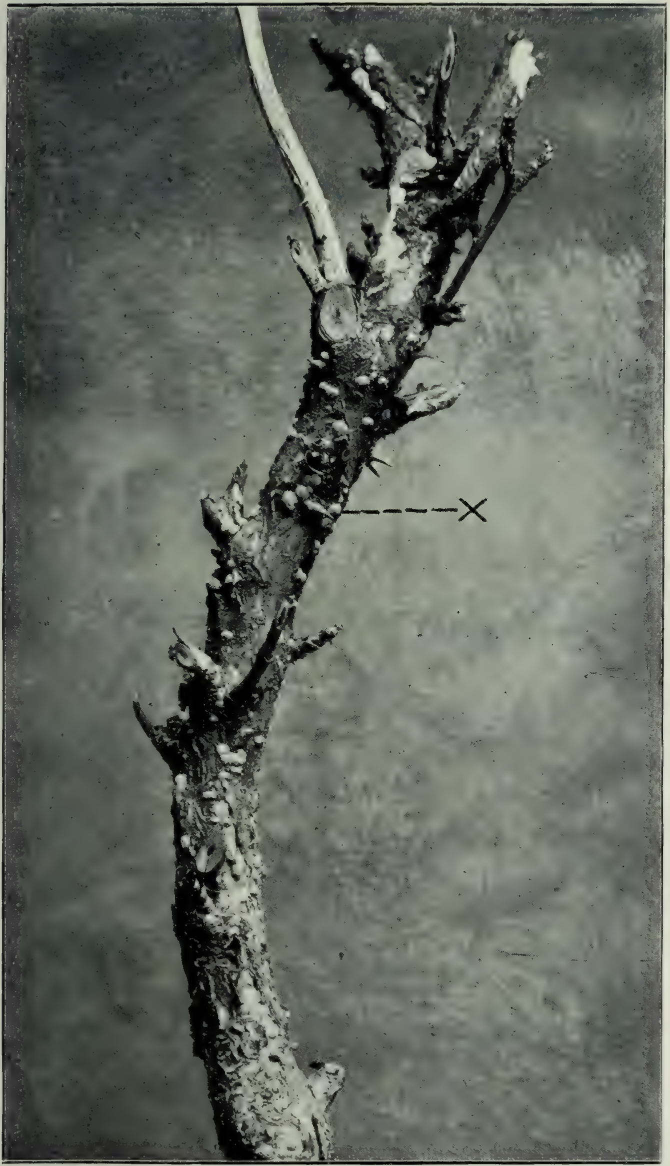
PLATE 36.



[*W. H. Hammond, photo.*

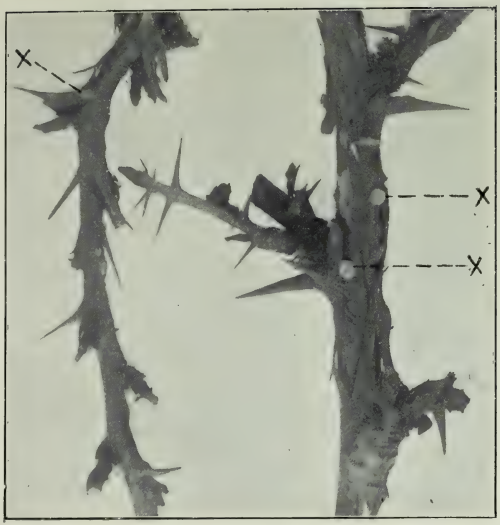
Portion of stem (just above ground level) of a diseased gooseberry bush. Fructifications of *Botrytis* can be seen appearing between the cracks of the bark.

PLATE 37.



Diseased gooseberry branch, showing the *Botrytis* fructification at X and elsewhere.

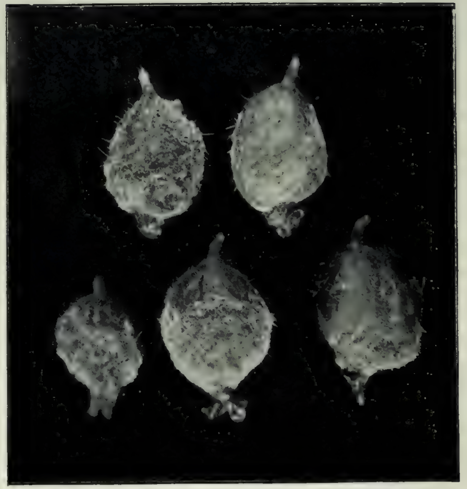
## PLATE 38.



[*W. H. Hammond, photo.*

Young diseased branches, bearing the fructification of *Botrytis* at X.

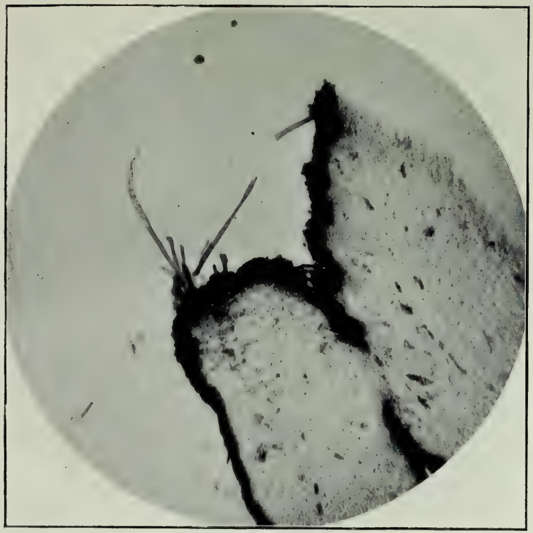
## PLATE 39.



[*W. H. Hammond, photo.*

Five gooseberries attacked and turned rotten; the *Botrytis* fructification has developed on their surface.

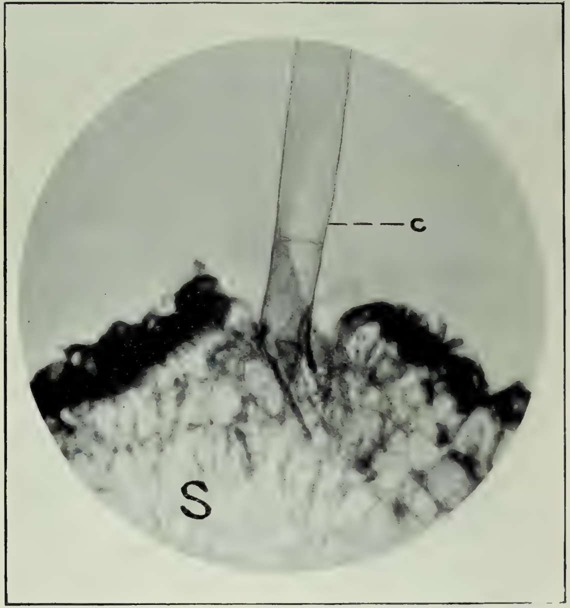
Plate 40.



[*W. H. Hammond, photo.*

Portions of two *sclerotia* (partly grown together) in section, showing the dark-coloured protective outer layer. The *sclerotium* to the left has commenced to give rise to the *Botrytis* fructification. Magnified.

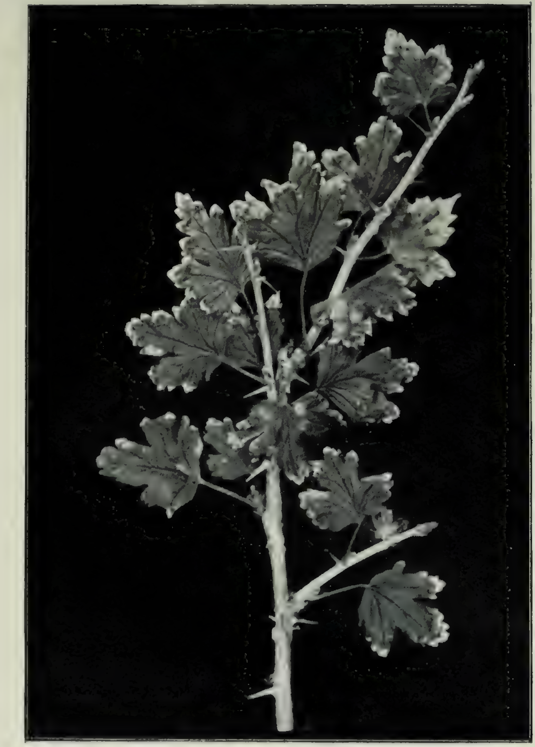
Plate 41.



[*W. H. Hammond, photo.*

Portion of another *sclerotium* (S), showing the base of a *conidiophore* arising from its tissue. Highly magnified.

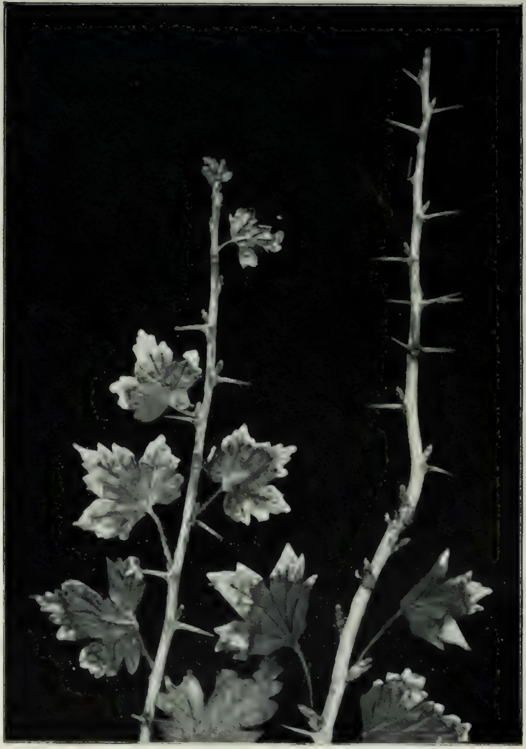
PLATE 42.



[*W. H. Hammond, photo.*

Shoot of "Whinham's Industry," with the leaves attacked at the edges by *Botrytis*.

PLATE 43.



[*W. H. Hammond, photo.*

Two shoots of "Whinham's Industry," showing the leaves affected more severely, and the tip of one (*to right*) killed by the fungus.

winters,—just as the summer stage of the apple "scab" fungus may be found on the young wood of apple trees throughout mild winters.

If a bush has been weakened by the *Sclerotinia* disease in previous seasons, then the renewed growth of the fungus during the spring will frequently cause the death of the bush. In the affected plantation gooseberry bushes here and there will suddenly wilt and die out in all stages of growth, most frequently at the stage when the leaf buds have just burst open, but often later when the bushes are in full flower, or when bearing young berries. If such bushes are examined the stem will be found to be "ringed" by the spawn of the fungus, and on the surface of the stem will be found the *Botrytis* fructification, as shown in Plate 36. If, however, the disease has not developed to a sufficient extent to kill the bush, the *spores* which are continually being produced throughout the spring and early summer *serve to spread the disease to other parts of the bush.*

Very commonly the spores infect the leaves, which under the attack soon show a discolouring at their edges. The edges of the leaves are first turned yellowish, and then become ash-grey, or whitish, as shown in the photograph at Plate 42. If the attack extends from the edge of the leaf inwards until the greater part of the leaf is affected—as is the case with many of the leaves shown in Plate 43—the fall of the leaf soon occurs; if, however, as is often the case, the injury remains restricted to the edges of the leaves, the latter remain on the bush until the usual time for the fall of the leaf. Whether the injury spreads over the leaf to such an extent as to make it fall prematurely seems to depend on the climatic conditions which prevail at the time. When a large number of leaves are attacked throughout a plantation and made to fall prematurely, serious damage is often inflicted; in such cases the berries produced are much smaller than on healthy bushes, and a quantity of unripened spindly shoots may be formed. *The under surface of the leaf is the part attacked*, and during the months of June and July the *Botrytis* fructification may be found here on leaves which show the appearance depicted in Plate 42.

Another part of the bush which may be attacked is the young wood. In the case of young bushes, especially, a considerable proportion of the young shoots may be attacked and much weakened or killed,—a fact which has caused growers to speak of the present disease as " die-back." In many of the shoots which are thus killed, *the fungus can be found wintering in the dead buds, and producing fresh conidiophores in the following spring*. Such a dead shoot is shown in Plate 43. These infested dead shoots may form a prolific source of infection. If, as I have seen happen in not a few cases, the prunings of *Botrytis*-affected bushes are left lying in a heap in a corner of the plantation (instead of being promptly burned), they will develop during the following spring an abundant crop of powdery tufts of *Botrytis*, the spores of which, in countless numbers, will be blown by the wind and carry the disease through the plantation. There is also the danger of cuttings being taken from *Botrytis*-infected bushes, when many of the young bushes thus obtained will become diseased. In one case investigated a lot of 2,000 young bushes of "Crown Bob," having become affected when in the nursery, were already seriously diseased when planted up.

Lastly, the fungus occasionally attacks the berry and turns it rotten. I have seen berries attacked and destroyed in plantations in Surrey, Kent and Somerset. The first sign of the appearance of the disease on the berry is the browning of the skin at some spot ; this browning gradually extends until one side of the berry shows obvious signs of softening and of being badly diseased. The *Botrytis* fructification, in the form of the characteristic ashy-grey " mould," then soon appears on the surface of the discoloured portions (see Plate 39), and the berry in a week or so is turned completely rotten and decays. A case which occurred at Reigate, Surrey, last season, may be mentioned as showing the course usually followed by the disease, and the manner in which it spreads through the bush from one part to another. In this case the bushes were of the " Lancashire Lad " variety and were growing in a garden. At the beginning of June a number of the berries hanging on several of the bushes attracted attention by suddenly appearing " blighted " ; it was also noticed that many of the berries were turning flabby instead of ripening, and fell to the ground, where after a day or two they became covered over with the same " mould." An examination of the berries showed the presence of *Botrytis*.

Throughout the first fortnight of June the disease continued to spread and finally the grower was obliged to gather the crop green in order to save those not already attacked. The source of this epidemic became apparent when the grower forwarded examples of the old branches and young wood from these bushes, since scattered here and there on the surface of these were numerous vigorous tufts of *Botrytis* as shown in Plates 37 and 38. These tufts were powdery with enormous numbers of *spores*, and it was these *spores*,—carried through the bushes by the wind or insects —which constituted a continuous source of infection to the berries. The leaves had not yet been attacked, and this made the "blighting" of the berries appear all the more strange, as otherwise there were no signs of disease evident—the tufts of *Botrytis* on the dying (not dead) branches not being apparent until searched for closely.

In the following case, where berries were attacked in the plantations of the National Fruit and Cider Institute, Long Ashton, near Bristol, the details were kindly forwarded to me by Mr. B. T. P. Barker, Director of that Institute. "The bushes which were planted about five years ago, are situated between bush apples. During 1908 and 1909 we lost about twenty bushes out of a total of 750 in our plantations—owing to attacks of the fungus on the main stem. In addition a considerable number of bushes were more or less seriously mutilated by attacks on the branches. In 1908, the foliage suffered seriously; this season the damage in this way has been slight, but the fruit has been attacked. A number of berries were attacked when ripe or nearly ripe; to all appearance the berries were perfectly sound and undamaged in any way up to the time of attack by the fungus. Not a large proportion of berries was affected; it would be very serious if the trouble were to develop, as the fruit is absolutely ruined when attacked. Similar damage has been common in market gardens in this locality."

### *Remedies.*

When once the life-history of this *Sclerotinia* is known, it is evident that the best measures to get rid of the disease are *the prompt removal and burning of all dead bushes or dead branches in the plantation.* As soon as the leaves of bushes show the appearance represented in Plate 43, the bushes in the plantation generally should be examined and any bush found with the main stem diseased should be grubbed up and burned. *The prompt removal of all dead (or dying) bushes carried out for a few seasons has proved more efficacious against this disease than spraying.* It must not be forgotten that this fungus (unlike the American Gooseberry Mildew) is capable of developing vigorously on *dead* parts of the bush. In nearly every case—except in the comparatively rare ones where a plantation has been planted up with *Botrytis*-infested young bushes—the disease appears first either on single bushes scattered here and there through the plantation, or on all the bushes over a small patch of ground in the plantation while the surrounding bushes are healthy. If the disease on its first appearance is dealt with summarily by the burning of all dead bushes and dead branches, there is no need—as I have been able to prove in several instances—to spray or to take any other remedial measures, since the disease soon completely disappears.

Where the disease has been allowed to become severe and widespread, or where it is not in the power of the grower to remove entirely the source of the disease, spraying must be resorted to,—in addition, of course, to the prompt burning of all dead bushes. A heavy spraying with a solution of copper sulphate (4 lbs. dissolved in 100 gallons of water) should be given just before the buds burst, with the object of destroying the tufts of *Botrytis* shown in Plates 36 and 37, care being taken to spray heavily the main stems of the diseased bushes. The infection and premature falling off of the leaves may be prevented by spraying, directly the fruit is set, with Bordeaux mixture.* In this spraying it is essential that the under surface of the leaves should be sprayed as much as possible. No injury follows the application of Bordeaux mixture, and if the spraying is done at the time indicated, no spotting of the berries occurs.

It may be noted, finally, that any treatment which induces the bushes to make vigorous growth tends to stop the attacks of the present fungus; whereas the opposite is the case with the American Gooseberry Mildew which attacks vigorously-growing bushes the most severely. The former characteristic is illustrated by the following case. A number of bushes of "Crown Bob," on which the current year's growth of wood had died back through being badly attacked by *Botrytis*, were planted in an old arable field, part of which was heavy clay with plenty of moisture, while part was of a much more friable nature with a gravelly subsoil. All the bushes were pruned very hard into two years' old wood before being transplanted. Those bushes which were planted in the heavy clay land made excellent growth the next season and showed no disease, while the remainder, which were on drier soil (though in the same field and adjoining the others) grew less vigorously and became severely attacked again by *Botrytis*.

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* A Leaflet giving directions for the preparation of Bordeaux mixture can be obtained on application to the Secretary.

## A new disease (*Sclerotinia*) of the Mangold.

(Plates 44 and 45).

During the winter of 1908-9 a farmer in East Kent sent in to the College some specimens of mangolds, taken from a clamp, which were being attacked by some disease. The characteristic sign of this disease was the discoloration of portions of the internal part of the root, which assumed a dark brownish or blackish hue. This was noticeable in an early stage of the disease (before any " rot " set in), and it was this that first attracted attention when the roots were being sliced and fed to stock. In a later stage of the disease portions of the surface of the root softened and turned brownish, and then soon afterwards a rapid " rot " set in, and the whole root decayed. Information was asked for as to whether these mangolds with discoloured flesh, but still firm and undecayed, were likely to be poisonous or to have an injurious effect on the stock to which they were fed, and also as to what could be done to stop the disease spreading in the clamp.

On examination it was found that the interior discoloured parts of the root were permeated by the spawn (*mycelium*) of a fungus. The threads, or *hyphae*, of the mycelium were filled with abundant protoplasm, and could be seen passing right through many of the cells* of the root and also occupying the intercellular spaces. These *hyphae* possess the power of secreting a ferment which is able first to soften and then to dissolve the walls of the cells ; further, they secrete another ferment which can attack and kill the living matter (*protoplasm*) within the cell, turning it brown. It is this destruction by the fungus of the living cells of the root that causes the discoloration noticeable in the present disease. The cells which are thus attacked and killed by the fungus, lose their turgidity as the result of the death of the protoplasm, and in consequence the cell-sap escapes into the spaces between the cells.

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* All vegetable substances are composed of little chambers called *cells*.

In this way the fungus obtains an abundant supply of food-material, feeding on the substances in the cell-sap and on the dead protoplasm. Gradually bacteria invade the tissues now broken down by the fungus, and through their agency a pulpy mass of decaying tissue soon results.

In the first stages of attack, *i.e.*, when otherwise sound roots show when sliced across a discoloration of the flesh, there is no reason to believe that any *poisonous* substances in appreciable quantities are being produced, and until any " rot " sets in the roots may be fed to stock.

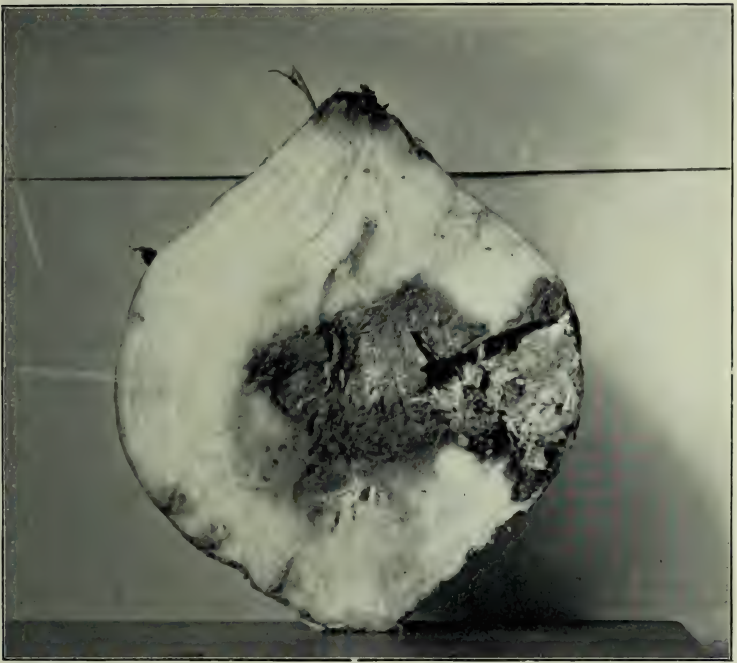
Cultures were made of the fungus, and its fructification obtained. It proved to be a species of *Sclerotinia* (*Botrytis*). The mycelium if allowed to develop in a mangold kept in a damp atmosphere, or if cultivated on a sterilised, nutrient medium consisting of agar and potato-juice, soon develops, on the surface of the root or of the nutrient medium, large extended patches of a greyish, fluffy " mould." This is the fructification of the fungus, and in this stage it has long been known under the name of *Botrytis*. Each fluffy patch of this *Botrytis* " mould " is seen under the microscope to be composed of a large number of upright dark-brown, bristle-like stalks (*conidiophores*) bearing a few short branches in the upper half. At the top of the main stem and also of each side branch, is a globular mass of many hundreds of very minute spores (*conidia*). It is these crowded upright branches, or *conidiophores*, densely packed side by side, and each bearing numerous heads of *conidia*, which give the tufts of the fungus its characteristic fluffy or minutely powdery appearance. Each spore (*conidium*) of the fungus, it must be noted, is able, just like the seed of higher plants, to give rise to another distinct individual of the same kind. A figure of the fructification of a species of *Botrytis* is given above at p. 321.

The fungus continues to produce the *Botrytis* form of fructification for some time, but eventually—usually when the part attacked is becoming disorganised and rotten—produces clusters of little bodies termed *sclerotia* (see Plate 45). Each *sclerotium* is a compact, solid body which varies in size and is somewhat irregular in shape, and consists of densely interwoven fungus *hyphae* ; it is at first dingy white, but soon assumes a blackish colour. These *sclerotia* contain a rich supply of reserve food-material, and are thus specially adapted to serve as a resting-stage. As a matter of fact, they are able to remain alive (though quite dormant, just like a seed) for several years, if the external conditions are unfavourable for fresh growth. On germination, each *sclerotium* produces at once—without the intervention of a mycelium—clusters of *conidiophores* of the *Botrytis* type. Microscopic views of sections of *sclerotia*, and of their germination, are reproduced in Plates 40 and 41, where the fungus is a species of *Sclerotinia* allied to the present one.

The following experiments were carried out to ascertain whether the present fungus alone was responsible for the decay of the mangold roots.

In the first experiment, commenced on March 25th, 1909, four roots of Mangold and two roots of Swede were selected. All were sound and healthy roots. The six roots were treated as follows: using a sterilised knife a triangular piece of flesh, tapering inwards to a point, was cut out. In the case of two of the mangold roots, and in one of the swedes, the interior surfaces of this "plug" were inoculated by placing on them a number of *conidia* obtained from some powdery tufts of *Botrytis* growing on the surface of some of the diseased mangolds which had been sent. After being inoculated, the "plug" was at once replaced (see Plate 44). In the case of the remaining mangolds and swede the plug was replaced without any *conidia* having been sown on its surfaces; these roots consequently served as "controls." All the roots were placed separately under bell-jars, round the edges of which cotton-wool was placed. On April 20th all the specimens were examined. Both of the mangolds which had been inoculated were seen clearly to have contracted the disease; in both roots the exterior surface of the "plug" was discoloured and brownish, and bore numerous powdery tufts of *Botrytis*, and also, here and there, round the edges of the cuts, patches of clustered *sclerotia*. In both specimens it could be seen, even from the exterior surface, that the fungus had extended from the "plug" into the surrounding portions of the root. On being cut through the centre the roots presented the appearance shown in Plate 44; here the blackish discolouration, characteristic of the disease, could be seen extending already (in twenty-six days) as far as two-and-a-half inches in all directions from the lower end

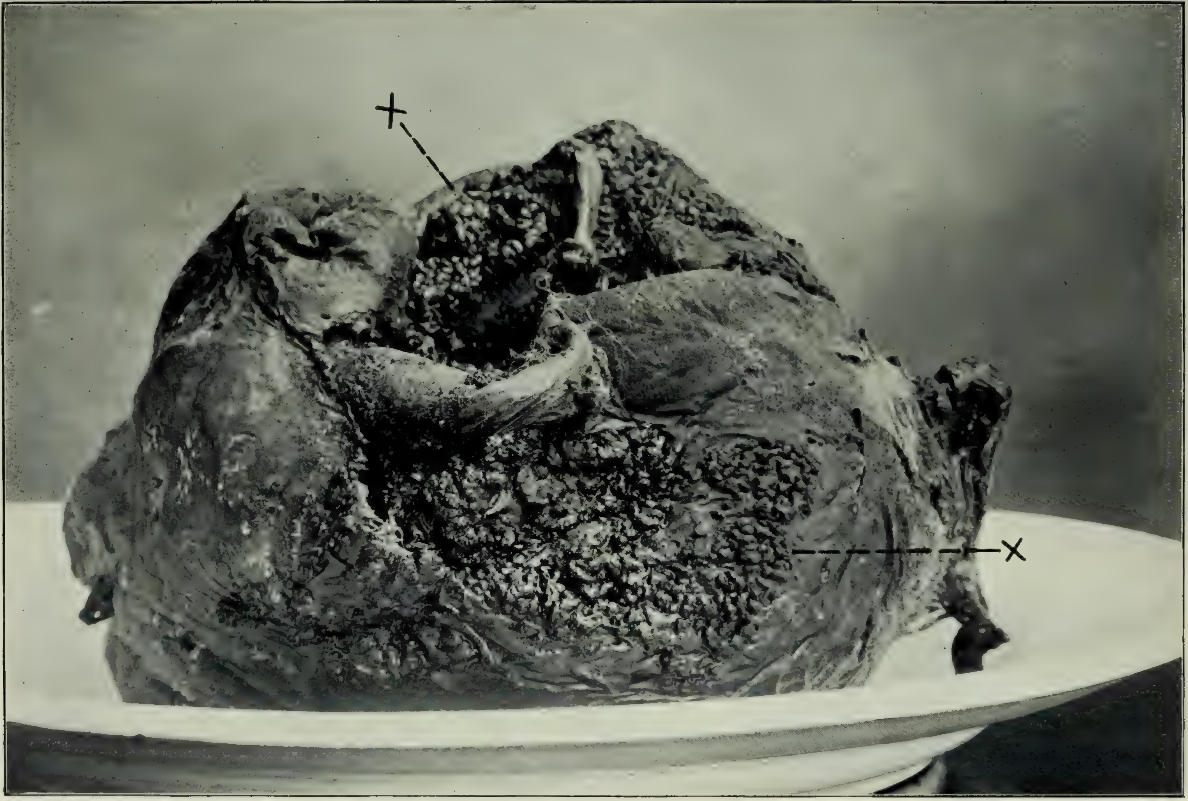
PLATE 44.



[S. T. Parkinson photo.

A Mangold attacked by the *Sclerotinia* (*Botrytis*) disease.
Section showing the "plug" (to right) where inoculation was made; the fungus has extended from this to the central parts of the root, as shown by the dark discoloration.

PLATE 45.



A Mangold attacked and destroyed by *Sclerotinia* (*Botrytis*) ; last stage of the disease.
Masses of *sclerotia* have been formed (at ×) by the fungus.

of the "plug." On microscopic examination it was found that not only this discoloured tissue, but also the apparently uninjured tissue for an inch or so surrounding it was permeated by the mycelium of the fungus. No bacteria were observed in this tissue. In the case of the two mangolds in which "plugs" had been cut, *but no inoculation made*, no disease was visible either at this date, or on May 13th, at the close of the experiment. As regards the swedes, the inoculated one developed, by April 20th, a plentiful crop of the *Botrytis* fructification, and also some *sclerotia*, on the exterior surface and at the edges of the "plug." The "control" swede was healthy when examined on April 20th; it was then inoculated with *conidia* placed on the interior surfaces of a new "plug" cut out on the opposite side to the old one. By May 13th infection had resulted; the exterior surface of the plug bearing both tufts of *Botrytis* and *sclerotia*.

In the second experiment started on April 3rd, 1909, two mangolds and two swedes were selected. All the roots were sound and healthy; a "plug" was cut in each as described above, and then at once replaced. In the case of *one* mangold and *one* swede, the interior surfaces of the "plug" were inoculated with the *Botrytis conidia* before the "plug" was replaced. The other mangold and the other swede thus served as "controls." The four roots were placed side by side in a closed glass receptacle. On April 17th an examination of all the roots was made. *The presence of the disease was observable only in the inoculated mangold*, where the exposed, exterior surface of the "plug" was slightly discoloured (though still quite firm) and covered over abundantly and almost continuously with powdery tufts of the *Botrytis*. The "control" mangold was perfectly healthy. Both the swedes showed at this date no signs of the disease. On the infected mangold being cut across a discoloration of the flesh was noticeable, radiating from the surfaces of the "plug" where the *conidia* had been sown. On sections being cut of this discoloured tissue, the *hyphae* of the fungus could be seen under the microscope, extending in all directions among the cells, feeding on the cell-contents, and gradually breaking down the tissue. No bacteria were present in the internal parts of the root. On the "control" mangold being cut across, no change in the colour of the flesh was observable,—showing that in the above case the discoloration was due entirely to the action of the fungus, and was not the after-effect of the injury inflicted in cutting out the " plug." By May 13th one of the swedes* had contracted the disease, and was now covered over, in the neighbourhood of the " plug," with an abundant growth of *Botrytis* and masses of large *sclerotia*. This was probably due to a secondary infection by *conidia* from the diseased mangold which lay close by its side.

An important point to be remembered in connection with this disease of mangolds is that species of *Botrytis* (in many cases probably the same species as this on mangold) are extremely common, practically everywhere, on dead or dying vegetable substances. Further, many species of *Botrytis* are well-known as the cause of destructive diseases on living plants. One species, very probably the same as the one here described, is known to be the cause of the decay of stored turnips and swedes (so often attributed to the action of frost). I cannot, however, find any previous record of mangolds having been attacked by *Botrytis*. A disease of gooseberries caused by a species of the genus is described above at p. 319. There are numerous accounts in mycological literature of more or less serious diseases caused by species of *Sclerotinia* (*Botrytis*) on the following plants, among others :—cabbages, potatoes, carrots, beet, cucumbers, kidney beans, onions, artichokes, fruits, lilies, dahlias, and seedlings generally.

Prof. M. C. Potter has shown that the *Botrytis* which is found on potato haulms can pass directly on to turnips and swedes. If a *sclerotium* is taken from a potato haulm, and placed in a damp atmosphere, it will produce in a few days its *Botrytis* fructification ; if some *conidia* are taken from this and sown on turnips or swedes infection will result.

It is worth noting here that the vitality of the *conidia* of *Botrytis* is not affected injuriously by ordinary frosts† ; the fungus can live (as a saprophyte) on the dead cells of frozen roots and then, invigorated by this saprophytic nourishment, invade the living parts of the root. Similarly, it is the wounded or bruised parts of mangold roots which undoubtedly afford the chief means whereby the present fungus obtains an entrance into the root. Any wounds (whereby the flesh of the root is exposed) made accidentally in removing the leaves, offer a favourable starting point for the disease if the *conidia* of the fungus are in the neighbourhood, especially if the roots are stored in a wet state. Then when any one root has been destroyed in the clamp, the fungus begins to spread by means of its mycelium or by the countless *conidia* which are usually produced,—the damp atmosphere of the clamp being of course very favourable for the growth of a fungus—until entrance is found in some crack or wound in the surface of adjacent roots.

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* The other had been removed.

† There is, indeed, reason to believe that frost has an invigorating effect on the germination and vitality of the *conidia*.

In the present instance the loss of only a few bushels of mangolds resulted. Where serious loss has occurred, the following precautions, based on our knowledge of the life-history of the fungus causing the disease, should be adopted :—

(1) Before making the clamp, clear up and burn all rubbish consisting of dead or decaying vegetable matter in the immediate neighbourhood.

(2) Ventilate the clamp as well as possible, and choose a spot where there is natural drainage.

(3) Cut or bruise the roots as little as possible, and reject carefully all roots that are not sound.

(4) Never use turnip, swede or mangold tops, or potato haulm, on the roof of the clamp,—as is the practice in some districts.

(5) Do not make a clamp again on the same piece of ground, for fear of *sclerotia* lurking in the soil.

# NOTES ON HOPS.

# NOTES ON HOPS.

By E. S. Salmon, F.L.S.

(Plates 1 to 7).

## 1. On the Influence of the Male Hop on the "Growing-out" of Hops.

The subject of the fertilisation of the flowers of the female hop by the pollen of the male hop, and the consequent rapid "growing out" of the hop to a larger size, was dealt with in detail in last year's *Journal.*

It is gratifying to be able to record that a considerable number of hop-growers in Kent and Surrey have become convinced by the evidence put forward in our leaflet*, as to the beneficial results obtained (under present conditions) by growing male hops in the garden. Not only have growers in many districts ceased from grubbing up male hops indiscriminately, but several have commenced to plant up male hops in the garden. During the past winter we have had applications from sixteen hop-growers farming in the districts of Faversham, Yalding, Ashford, Wye, Paddock Wood, Lamberhurst, Pembury, East Farleigh, Dover, Hartlip, Rainham, Ash, Tenterden (Kent), Farnham (Surrey), and Ledbury (Worcestershire) for cuttings from male hops grown in the College garden. In response to these applications a few cuttings of a male hop selected to flower at the particular time desired were sent to each grower. That is to say, according to requirement, the male hop sent was one that was known to flower (in the College garden) early, medium, or late,—the object aimed at being that the male hop sent should flower and produce its pollen *during the time the variety of hop among which it was to be planted was in "burr."*

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* A copy of this Leaflet can be obtained on application to the Secretary.

We should like to repeat here the offer we made last year to send to any hop-grower in Kent or Surrey (free of all cost except carriage) a few cuttings of a suitable male hop for growing in a garden planted with any particular variety. We cannot of course undertake to supply male hop sets in large quantities, but we shall be pleased to send any grower a few cuttings from which he can raise his own stock of suitable male hops.

As there has been some misunderstanding, I should like to point out here that in planting up male hops no particular variety is necessary,—that is to say, it is not necessary to obtain, for instance, a " Fuggles male " for a garden of Fuggles, or a " Brambling male " for a garden of Bramblings. As a matter of fact, male hop plants cannot be distinguished as belonging to any particular variety. There is one character, and one character only, which the male hop to be planted must have, viz., *it must flower at the time when the hops among which it is planted will be in " burr."* Too often the male hops which are planted, or which appear spontaneously in a garden, flower too early, so that they are out of flower at a time when the surrounding hops are still in full " burr." *Such male hops are useless in a garden.* The grower should note carefully the date when the varieties of hops grown by him are in full burr ; then if he requires male hops to plant in any garden where the hops do not grow out properly, he can obtain, by sending us particulars, male plants which flower at that particular time.

In connection with the present point, I may mention here the following fact concerning a number of male hop plants (in the College garden) which I kept under observation during the past season (1908). The date and the duration of flowering of sixty-seven male hop plants were noted. The earliest male began to flower on July 13th ; the latest on August 14th. The number of male hops which were *out of flower* by August 9th was twenty-three. *Now the hops (Canterbury Whitebine) in the College garden were in full burr on August 9th, consequently any one of the above-noted twenty-three male hops if planted in such a garden would be useless.* One of the later flowering male hops, beginning to flower about August 1st, of which there are a considerable number among our stock of male hops, would be the right kind of male to plant among these Canterbury Whitebines.

The duration of the time of flowering of a male hop varies from twelve to twenty-six days. Male hops should be planted which produce pollen during the entire period when the female hops are in " burr." If this is done, the " burr " will develop into hop very quickly, and the risk of mould getting into the " burr " will be greatly diminished.

That it is a point of great practical importance to plant male hops which flower at the time of the appearance of the " burr " was shown clearly by the facts given in last year's *Journal,* where it was pointed out that the presence of such male hops in a garden caused an increase in yield equivalent to 4 cwt. per acre and an improvement in the character of the hops which resulted in an increase in price of from 30s. to 25s. per cwt.

A striking case of the influence of the male hop on the " growing out " of Golding hops was observed last season in a garden of " Early Birds." In Plate 1 we have a photograph of two branches, on the same scale, of the " Early Bird " hop, taken from different parts of the same garden. It will be seen at once that the hops are properly grown out in the left-hand branch only. An examination of the garden showed conclusively that the difference in the " growing out " of the hops noticeable in different parts of the garden could not be attributed to any difference in the vigour of the hills, nor to the soil or position in the garden. The cause of the difference was found on picking to pieces the hops of the two branches shown in Plate 1.

Table A on next page gives the structure* of the nine largest hops of the left-hand branch.

We see then that in the hops which are properly " grown out," each hop consists of from twenty-eight to forty-seven bracteoles, and contains from six to eighteen seeds per hop. We will call these the " seeded " hops.

Table B gives the structure of the twelve largest hops of the right-hand branch shown in Plate 1.

Here we see each hop is composed of from twenty-eight to forty-six bracteoles, *and is either quite seedless* or contains

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* The botanical structure of a ripe hop is explained in detail in our Leaflet. The number of *bracts* is not given in the Tables because they are invariably sterile, and occur always in the proportion of one *bract* to every two *bracteoles.*

TABLE A.

| Number of Hop in Plate | Length of Hop in Inches. | Number of Seeded Bracteoles. | Number of Seedless Bracteoles. | Total Number of Bracteoles. |
|---|---|---|---|---|
| 1 | 1 3/4 | 9 | 38 | 47 |
| 2 | 1 1/2 | 10 | 29 | 39 |
| 3 | 1 5/8 | 11 | 27 | 38 |
| 4 | 1 1/4 | 6 | 22 | 28 |
| 5 | 1 3/4 | 18 | 26 | 44 |
| 6 | 1 1/4 | 7 | 25 | 32 |
| 7 | 1 1/4 | 9 | 21 | 30 |
| 8 | 1 3/4 | 11 | 30 | 41 |
| 9 | 1 1/4 | 8 | 20 | 28 |

TABLE B.

| Number of Hop in Plate | Length of Hop in Inches. | Seeded Bracteoles. | Seedless Bracteoles. | Total Number of Bracteoles. |
|---|---|---|---|---|
| 1 | 1 1/4 | 2 | 44 | 46 |
| 2 | 1 | 1 | 33 | 34 |
| 3 | 7/8 | 0 | 36 | 36 |
| 4 | 1 1/8 | 0 | 40 | 40 |
| 5 | 1 | 0 | 40 | 40 |
| 6 | 7/8 | 0 | 38 | 38 |
| 7 | 1 | 1 | 27 | 28 |
| 8 | 7/8 | 0 | 34 | 34 |
| 9 | 1 | 2 | 26 | 28 |
| 10 | 3/4 | 0 | 30 | 30 |
| 11 | 1 | 0 | 40 | 40 |
| 12 | 3/4 | 0 | 28 | 28 |

one or two seeds only. We will call these the "seedless" hops.

Now let us compare, in the following Table, those hops (from the two branches shown in Plate 1), which are composed of approxmately the same number of bracteoles.

| "Seeded" Hops. | | "Seedless" Hops. | |
|---|---|---|---|
| Number of Bracteoles. | Length of Hop in Inches. | Number of Bracteoles. | Length of Hop in Inches. |
| 28 | 1¼ | 28 | 1 |
| 28 | 1¼ | 28 | 1 |
| 30 | 1¼ | 30 | ¾ |
| 32 | 1¼ | 34 | 1 |
| 38 | 1⅝ | 38 | ⅞ |
| 39 | 1½ | 40 | 1 |
| 41 | 1¾ | 40 | 1 |
| 44 | 1¾ | 46 | 1¼ |

This Table shows us that hops having the same "structure," *i.e.*, the same number of bracteoles and bracts (or, as growers would say, the same number of "petals"), vary in size according as they contain seed or not, *i.e.*, according as the "burr" has been fertilised or not by pollen from a male hop. The "seeded" hops shown in the left-hand branch in Plate 1 show an increase in length of from ½in. to ⅞in. over the "seedless" hops of the right-hand branch, *although the structure of both is the same.* Now this increase in length of the "seeded" hop means a considerable difference in the weight of the crop. In a careful estimate made in another case,* it was found that an average increase of ¼in. in the length of the hop means an increase in weight of 4 cwt. per acre. In the present case the increase in length would mean an increase of some 5 or 6 cwt.

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* See *Journal* S.E. Agric. College, vol. xvii., p. 381 (1908).

per acre. In other words, the small hops of the right-hand branch could be transformed into the large, properly "grown out" hops of the left-hand branch—a change meaning an increase of some 5 or 6 cwt. per acre—*simply by the planting of male hops which flower at the time when these "Early Birds" are in "burr."*

Evidence establishing the same point is supplied by the hops shown in Plates 2 and 3. In each case we have a bunch of four small hops by the side of four properly grown-out hops. The variety is the "Early Bird." Taking first the hops shown in Plate 2 it was found on examination that the larger hops (to right) were composed as follows :—

| Number in Plate 2 (to right). | Length of Hop in Inches. | Number of Seeded Bracteoles. | Number of Seedless Bracteoles. | Total Number of Bracteoles. |
|---|---|---|---|---|
| 1 | 1 | 4 | 20 | 24 |
| 2 | 1⅛ | 5 | 25 | 30 |
| 3 | 1¼ | 11 | 19 | 30 |
| 4 | 1½ | 7 | 33 | 40 |

In this case, we see, the hops are well "grown out," 1 inch or over in length, contain from four to eleven seeds, and are composed of from twenty-four to forty bracteoles.

The smaller hops (Plate 2, to left) were examined, and found to be composed as follows :—

| Number in Plate 2 (to left). | Length of Hop in Inches. | Number of Seeded Bracteoles. | Number of Seedless Bracteoles. | Total Number of Bracteoles. |
|---|---|---|---|---|
| 1 | 1 | 1 | 29 | 30 |
| 2 | 1 | 1 | 37 | 38 |
| 3 | ⅞ | 0 | 34 | 34 |
| 4 | 1 | 0 | 44 | 44 |

Here we have much smaller hops, not properly grown out, and not exceeding an inch in length. This is not due, as we see, to these hops being composed of a smaller number of bracteoles, *but to the absence of seed in the hop.*

With regard to Plate 3, the larger hops (to left) were composed as follows :—

| Number in Plate 3 (to left). | Length of Hop in Inches. | Number of Seeded Bracteoles. | Number of Seedless Bracteoles. | Total Number of Bracteoles. |
|---|---|---|---|---|
| 1 | 1½ | 11 | 29 | 40 |
| 2 | 1¼ | 5 | 25 | 30 |
| 3 | 1¼ | 11 | 19 | 30 |
| 4 | 2 | 15 | 35 | 50 |

The seeds were distributed at intervals along the hop, and so had the full effect of lengthening the hop.

The smaller hops (to right) were composed as follows :—

| Number in Plate 3 (to right). | Length of Hop in Inches. | Number of Seeded Bracteoles. | Number of Seedless Bracteoles. | Total Number of Bracteoles. |
|---|---|---|---|---|
| 1 | 1 | 0 | 30 | 30 |
| 2 | 1⅛ | 0 | 30 | 30 |
| 3 | 1 | 0 | 30 | 30 |
| 4 | 1⅝ | 2 | 50 | 52 |

Here, again, we see that the reason why the small hops in Plates 2 and 3 did not " grow out " was the absence of seed.

The point of practical importance then for the hop-grower is this : that hops of the size shown in Plate 2 (to left) and Plate 3 (to right) will grow respectively to the size shown in Plate 2 (to right) and Plate 3 (to left), *if male hops (which flower at the right time) are planted in their neighbourhood.*

The facts obtained by the systematic examination of a sample of the crop in the College hop-garden for the past four seasons afford striking evidence as to the effect of fertilisation in increasing the crop. The following table gives the particulars obtained from the crops grown in 1906 to 1909, the figures being the result of an examination of a sample of a hundred hops taken each season from the "green bags" at the time of picking.

| | Average length of Hop in inches. | Average No. of Bracteoles per Hop. | Average No. of Seeds per Hop. | Ratio of Seeded to Seedless Bracteoles. |
|---|---|---|---|---|
| 1906 | .85 | 27 | 1.1 | 10 to 233 |
| 1907 ("seedless area"*) | .75 | 28 | .5 | 10 to 495 |
| 1907 ("seeded area"*) | 1.10 | 27 | 9.7 | 10 to 18 |
| 1908 | 1.17 | 30 | 10.2 | 10 to 19 |
| 1909 | 1.19 | 29 | 13.6 | 10 to 11 |

It can be seen plainly that the gradual increase in the length of the hop from .85 in. in 1906 to 1.19 in. in 1909 has been dependent on the increase in the number of seeds per hop. This is due entirely to the influence of male hops on the garden. Further, the quality of the hops has undoubtedly been improved from the market standpoint, as proved by the prices obtained for these hops. In 1906 the hops were not grown out because of the non-production of sufficient seed; in 1909 the hops were well grown out because of the production of sufficient seed.

## 2. On the Production of "Seedless" Hops.

The fact was pointed out last year† that it is not possible in the case of the Golding varieties of hops at present grown in this country to produce a crop of *seedless* hops which are "grown out" sufficiently to obtain a good price on the market. English Golding hops, unless "seeded" to a certain extent, invariably remain small, and then command a very inferior price. On the other hand, certain German varieties of hops which are grown in Bavaria, produce *large seedless* hops. The explanation of this fact is that the number of *bracts* and *bracteoles* (or " petals," as these are called collectively by the grower) is greater in these German varieties than in the English Golding varieties. In the latter the average number of bracteoles* per hop varies from twenty to thirty-five, and is usually about twenty-nine, while in certain German varieties it is from forty to fifty or more.

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* See Leaflet, obtainable on application to the Secretary.

† *Journal* S.E. Agricultural College, vol. xvii., p. 381 (1908).

The English grower must not lose sight of the fact that he cannot grow a large Golding hop which is seedless until he can obtain a variety which produces a much larger number of bracteoles per hop than any variety at present grown commercially in this country. If the English grower were to wish to grow hops of the seedless type produced in certain districts in Germany, he would have first of all to plant his gardens with a new variety of hop, viz., one that produces a large number of " petals " per hop, and then eradicate all male hops in the neighbourhood in order to grow seedless hops. Under existing conditions in England, however, as was pointed out in full detail in this *Journal* last year, it is absolutely essential in order to obtain well grown out Golding hops, to have them more or less seeded, and therefore the grower must be careful to provide a certain number of male hops to every garden,—unless these happen to be growing in other gardens in the neighbourhood.

In the light of the above remarks it is obvious that any facts relating to the existence of varieties of hops growing in this country which produce a greater number of bracteoles per hop than those at present in general cultivation will be of interest.

The first variety which may be mentioned is a German hop labelled " Stirn," which has been grown for a number of years in the College hop-garden. A fair sample (consisting of seventy-five hops) of this variety was taken, and each hop examined. The examination showed that the average length of the hop was 1⅔ in. ; that the average number of seeds per hop was thirteen ; and *that the average number of bracteoles per hop was forty-one.* Now this "Stirn" hop is a very early-flowering variety, and on this account many of the hop flowers, *i.e.*, the "burr," remain unfertilised, owing to there being no male hops in flower at this time of the year, with the result that many seedless hops are produced. It was found that among the seventy-five hops which were taken and examined, eleven hops were absolutely seedless and ten hops contained only one seed each. The average length of these twenty-one "seedless" hops, as they may be called, was $1\frac{1}{10}$ in.; the average number of bracteoles per hop was forty-one. *Now such a hop as this is exactly similar in structure to the hop produced in the best hop-growing districts of Germany.* In other words, it is possible to grow in England a German variety of hop which, under the soil and weather conditions of this country, will produce a sufficient number of "petals" per hop to enable the grower (if he excludes all pollination from his garden) to grow a seedless hop of sufficiently large size. While, however, this "Stirn" variety is one which, when grown in this country, produces the necessary number of bracteoles for the production of a fair-sized seedless hop, its coarse flavour and poor cropping qualities would probably render it useless for the English grower. These and other points, however, have yet to be investigated further.

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* For every two *bracteoles* there is present one *bract,* and their combined number gives the number of " petals " in the hop.

One interesting point may be noted here. We see that in the above case about forty bracteoles per hop are required in order to produce a "seedless" hop of about 1 in. in length. As was pointed out last year, in the case of Golding (Canterbury Whitebine) hops, twenty-eight bracteoles per hop will produce a seedless hop only $\frac{3}{4}$ in. in length. We wrote then "Before we can think of growing a seedless hop in this country, the grower must be provided with some new varieties of hops which will produce on a average forty or more bracteoles per hop, instead of the twenty-four to twenty-eight bracteoles [very rarely rising to over thirty] which is the average number produced by the English varieties under the present methods of cultivation."

The second hop to be noted is another variety of German origin (Lower Bavarian), and of better flavour. These hops, seventy-five of which were sampled, had been exposed to pollination from the numerous male hops grown in the College experimental hop garden, and consequently contained a large amount of seed, the ratio of seeded to seedless bracteoles being as ten to six.* The average length of the hop was $1\frac{1}{4}$ in. ; *the average number of bracteoles per hop was thirty-seven.* This number is somewhat greater than that found in any Golding variety of hop. Experiments will be carried out with the object of ascertaining whether seedless hops of a satisfactory size can be obtained in this country with this Lower Bavarian hop.

We may note next a hop which is of seedling origin (Plate 4). The plant was obtained in 1904 by Prof. A. Howard, when at Wye College, by "crossing" a plant of the Saaz (Bavarian) variety of hop with pollen from a male hop growing in the Canterbury Whitebine garden at Wye College. One of the seedling plants resulting from this "cross" produces an early, very large hop, which retains still some of the Bavarian flavour of the female parent. Hops exceeding 2 in. in length are not uncommonly produced by this plant ; the three hops shown in Plate 4 measured respectively (from left to right) $2\frac{3}{4}$ in., $2\frac{3}{4}$ in., and $2\frac{1}{2}$ in., and contained no less than seventy-six, seventy-four and sixty-six bracteoles each. The actual hops shown here were well-seeded (containing respectively fifty, thirty-six and thirty-nine seeds), and it remains to be seen whether, as seems probable, this seedling hop with its large number of bracteoles per hop can produce in this country *large seedless hops.*

In a sample of fifty hops of this "seedling," the average length was $1\frac{4}{5}$ in. ; the average number of bracteoles forty-seven ; and the ratio of seeded to seedless bracteoles ten to six. In 1907 and 1908 "box" samples were dried, and the following opinions on its flavour were obtained from various factors and merchants : "medium" ; "peculiar" ; "Bavarian flavour, worth going on with" ; "coarse." The present seedling will be used in further crosses and experiments.

## 3. "Seeded" and "Seedless" Hops in English and German Varieties.

The following experiment was carried out, using Canterbury Whitebines. Just before the "burr" appeared, twenty-four lateral branches were enclosed in paper bags,—so as to prevent pollen from a male hop reaching the "burr" when this appeared.

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* A Table showing the ratio of seeded to seedless bracteoles in samples from various hop-gardens in Kent, Surrey and Sussex is given at p. 354.

When these laterals came fully into "burr," twelve of the bags were taken off for a moment while pollen was dusted over the "burr" with a fine paint brush; the bag was then replaced. The laterals in the remaining twelve bags were untouched; and it was so arranged that of every two laterals springing from either side of the same bine, the "burr" of one was dusted over with pollen, and the bag then replaced, while the other received no pollen, and remained enclosed in the bag. Three weeks afterwards, the bags were removed from all the laterals. Thus both sets of laterals received the same treatment, except that one set of twelve was supplied when "in burr," with pollen from a male hop.

Seven days after the pollen had been supplied, it was noticed that practically all the "burr" had disappeared from the twelve laterals which had been treated, while those to which no pollen had been supplied remained in full "burr." Sixteen days later the unpollinated hops still showed some "burr," while all the pollinated branches had developed into fair-sized hops. Finally, the twelve pollinated branches produced well grown out seeded hops, while the twelve unpollinated branches produced small seedless hops not properly grown out. One hundred hops of each kind were taken, and each hop picked to pieces, and the results tabulated. The "seeded" hops were found to average nearly $1\frac{2}{5}$ in. (1.38 in.) in length, and to contain on an average six seeds; the "seedless" hops were entirely seedless, with an average length of just under 1 in. (.96 in.).

Here, then, we have further proof of the fact demonstrated in previous experiments, viz., that the fertilisation of the "burr" (resulting in the presence of seeds in the hop) means an increase in the length of the hop. In an instance previously recorded,* where "seeded" hops exceeded the "seedless" hops by $\frac{1}{4}$ in., this difference was found by actual weighing to be equivalent to an increase of 4 cwt. per acre. In the present case there was a difference of $\frac{2}{5}$ in. in the length of the "seeded" as compared with the "seedless" hops,—equivalent to an increase of over 6 cwt. per acre. This increase could be obtained by the grower by simply planting a male hop (flowering at the right time) in the neighbourhood. It should be noted that the average length of these seedless hops was under 1 in., that is to say, the hops were so small that they would be classed as not properly " grown out," and would fetch an inferior price on the English market.*

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* See *Journal* S.E. Agricultural College, vol. xvii., p. 381 (1908).

In Plates 6 and 7 photographs are given of the " seeded " and " seedless " Golding hops obtained in the above experiment.

One interesting point remains to be noted, viz., the increased number of bracteoles per hop which occurred in the above experiment. The average number of bracteoles per hop in both these " seeded " and " seedless " Golding hops was thirty-nine. As a comparison, a hundred hops from adjacent hills of the same variety were taken; here the average number of bracteoles per hop was found to be between twenty-nine and thirty (29.67). It is possible that the increased number of bracteoles which was shown by the hops in the above experiment was due to the fact that the end of the lateral branch had as a rule to be cut off in order to get branches enclosed in the bags. Further experiments will be made to determine this.

One of the most important points to note in the above experiment is the fact that these seedless Golding hops composed of about thirty-nine bracteoles each are similar in structure to German " seedless " hops. In Plate 5 photographs are given of " seeded " and " seedless " Golding hops and of " seedless " Hallertaus.

A detailed examination of the six hops photographed in Plate 5 reveals two interesting facts. Let us take first the two " seeded " Golding (Canterbury Whitebine) hops shown at Fig. 3; here the left-hand hop was 1¾ in. long, and composed of forty bracteoles, thirteen of which were " seeded "; the right-hand hop was 1⅜ in. long, and composed of thirty-eight bracteoles, sixteen of which were " seeded." Turning now to Fig. 2, we have two hops grown in Germany from Golding sets obtained some years ago from England; the left-hand hop was 1⅛ in. long, and composed of forty-two bracteoles, none of which was " seeded "; the right-hand hop was 1 in. long, and composed of thirty-eight bracteoles, none of which was " seeded." Here, then, we see that the effect of depriving Golding hops of all " seed " is to cause a decrease in length of from ⅜ in. to ⅝ in. It must be noted, further, that the number of bracteoles, viz., thirty-eight, which we find is here required to make a seedless Golding hop an inch long,—a length which may perhaps be considered sufficient to class a hop as " grown out," according to English standards—is considerably above the average number, viz., twenty-nine, found in Golding hops grown in this country.

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* See *Journal* S.E. Agricultural College, vol. xvii., p. 381 (1908).

Turning now to Fig. 1, we come to the second interesting point. Here the two hops are Hallertaus, grown in Germany; the right-hand hop was $1\frac{1}{8}$ in. long, and composed of fifty-two bracteoles, none of which was " seeded " ; the left-hand one was 1 in. long and composed of forty-eight bracteoles, none of which was " seeded." Comparing these with the two seedless Golding hops shown at Fig 2, we see that although the Hallertaus have ten more bracteoles per hop, the respective length of the hop remains the same. Here we have exhibited what is probably a varietal character of two different hops, viz., the more crowded position of the petals on the " strig " of the Hallertaus. This crowding together of a larger number of " petals" per hop would give a somewhat different appearance to the " side " of a sample of seedless Hallertaus to that of a sample of seedless Goldings.

Comparisons have been made with samples of the following hops grown in Germany; each hop being picked to pieces and the results tabulated.

*Sample* 1 consisted of twenty-five Bavarian hops sent by Messrs. Cattley, Gridley & Co. These averaged $1\frac{1}{10}$ in. in length; the number of bracteoles per hop was forty-nine; the number of seeds per hop was .8 (*i.e.* four seeds to every five hops); and the ratio of seeded to seedless bracteoles was 10 to 600. We have here what may be called the typical " seedless " German hop, and it is to be noted that the size of the hop, *i.e.* its length of $1\frac{1}{10}$ in. is only obobtained *in the absence* (*practically*) *of seed*, by the production of, on an average, forty-nine bracteoles per hop.

*Sample* 2 consisted of twenty-five hops of some unspecified German variety, sent by Messrs Cattley, Gridley & Co , from a " low class ground." The average length of the hop was $\frac{3}{4}$ in.; the number of bracteoles per hop twenty-eight; the number of seeds per hop .16 (*i.e.* four seeds to every twenty-five hops); and the ratio of seeded to seedless bracteoles 10 to 7040. The interesting point to note here is the fact that when the variety of hop grown in Germany is one which produces on an average only twenty-eight bracteoles per hop,—which is about the average found in the English Golding varieties,—and the hops are kept seedless, a small hop of only $\frac{3}{4}$ in. in length is produced, for which in England only a very inferior price would be paid. This fact would indicate that the ability of the German grower to grow *large* seedless hops is dependent on his growing certain varieties which produce a considerably greater number of bracteoles per hop than those varieties grown by the English grower, Investigation is necessary to ascertain whether the production of a larger number of bracteoles,—a character found in most German varieties—is due to soil, climate or method of cultivation, or whether it is due to the inherent nature of the variety.

*Sample* 3 consisted of twenty-five hops sent by Messrs. Cattley, Gridley & Co., and labelled "prime Hallertaus." These hops averaged 1$\frac{2}{10}$ in. in length; the number of bracteoles per hop was fifty-four; the number of seeds per hop .3 (*i.e.* three seeds to every ten hops); and the ratio of seeded to seedless bracteoles 10 to 1091. These *large, practically seedless* hops, containing a very large number of bracteoles per hop, may be taken as typical of the best German hops, and are strikingly different from the well-seeded English Golding hop which contain about twenty-nine bracteoles. It is possible that the twenty-five hops of this sample may have been partly selected for their large size (and so are not a true average sample), and that this variety does not on an average produce so great a number as fifty-four bracteoles per hop; but at any rate these hops demonstrate the fact very clearly that if a *large seedless* hop is desired it can only be obtained if the variety of hop grown is capable of producing a very large number of bracteoles—a much larger number, it may be noted, than any known Golding variety at present grown in England.

*Sample* 4 consisted of twenty-five hops sent by the "Deutscher Hopfenbau-Verein," Nürnberg, and labelled "Hersbrucker später Gebirgshopfen." These hops averaged 1$\frac{2}{10}$; the number of bracteoles per hop was thirty-three; the number of seeds per hop five; the ratio of seeded to seedless bracteoles 10 to 50. The comparison of these hops with the last sample is very instructive. We find an equally large hop in both samples, and yet in the present case the average number of bracteoles per hop is only thirty-three as against fifty-four in the last sample. The explanation is found in the fact that whereas the Hallertaus were "seedless," containing only three seeds to every ten hops, these "Hersbrucker" hops are *slightly seeded*, containing fifty seeds to every ten hops. From the statistics we have collected it seems certain that had these hops been seedless they would have averaged less than an inch in length. The amount of seed present in this sample of German hops is the same as is sometimes found in English hops,*—usually, it may be noted in hops that are not well grown out; the slightly greater number of bracteoles per hop in the German variety favoured the better growing out of these hops. Such German hops as these approximate in structure the English type of hop; among German hops they rank among the coarser inferior kinds.

*Sample* 5 consisted of twenty-five hops sent by the "Deutscher Hopfenbau-Verein," Nürnberg, and labelled "Striesselspalter." The average length of the hop was $1\frac{1}{10}$ in.; the average number of bracteoles per hop thirty-five; the number of seeds per hop one; the ratio of seeded to seedless bracteoles 10 to 350. This is an interesting case to compare with the last, as the hops here, notwithstanding an increase in the number of bracteoles per hop, show a decrease in the length of the hop; this is due to the production of less seed,—viz., one seed per hop instead of five seeds. This may be taken like Samples 1 and 3 as a characteristic "seedless" German hop, and we see that, in the absence (practically) of seed it requires thirty-five bracteoles per hop to build up a hop $1\frac{1}{10}$ in. long.

*Sample* 6 consisted of fifty hops, sent by Messrs. Wigan, Richardson & Co., and labelled "Marzill Hallertaus." These averaged $1\frac{1}{10}$ in. in length; the average number of bracteoles was thirty-eight; the number of seeds per hop three; and the ratio of seeded to seedless bracteoles 10 to 120. Here we see that, notwithstanding the considerable number of bracteoles per hop and also the presence of some seed, the length of the hop is only $1\frac{1}{10}$ in.

*Sample* 7 consisted of fifty hops of the English Golding variety, *but grown in Germany since 1893*, and sent by Messrs. Wigan,

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* See Table 1 at p. 354.

Richardson & Co. These averaged 1 in. in length; the average number of bracteoles per hop was thirty-five; the number of seeds per hop one; the ratio of seeded to seedless bracteoles 10 to 310. This sample forms one of the most interesting cases examined. The small size of the hops—which in England would be classed as not properly grown out hops, and which consequently would command only a very inferior price—is the direct result of the almost total absence of seeds. The hops have been able to attain the average length of 1 in. owing to the number of bracteoles per hop being thirty-five; we know, from previous investigations, that in this country the same variety of hop produces as a rule only from twenty-seven to thirty bracteoles, and that when grown seedless attains an average length of only $\frac{3}{4}$ in., or when seeded to the extent of the Marzill sample described above, an average length of $\frac{4}{5}$ in.

To summarise;—all the evidence supplied by the above samples confirms strikingly the opinion expressed in this *Journal* last year, that "for English growers to attempt to grow at the present time "seedless" Golding hops would be the most disastrous step they could take."

Tables are given on pages 354 to 356 of samples of English and German hops for comparison.

The main points of interest of Table 1 have already been pointed out in a previous article*; a few remarks may be made here on Table 2. We see here very clearly the same fact which is demonstrated in Table 1, viz., that in many cases the presence or absence of seed determines whether the hops have "grown out" or not.

Take the case first of Cobb's Golding, Samples Nos. 1 and 3. In the latter, with the average number of bracteoles per hop only twenty-two, we find the average length of the hop is $1\frac{1}{5}$ in., due to each hop containing on an average six seeds; while in the former case (Sample No. 1) the hops, though possessing an increased number (twenty-six) of bracteoles, are small and not "grown out" (averaging only 1 in.), because they are almost seedless. In another sample (No. 6) where the average number of bracteoles per hop rises to twenty-eight, the hops are still not "grown out" (averaging only 1 in. in length), because they contain only 3.5 seeds per hop.

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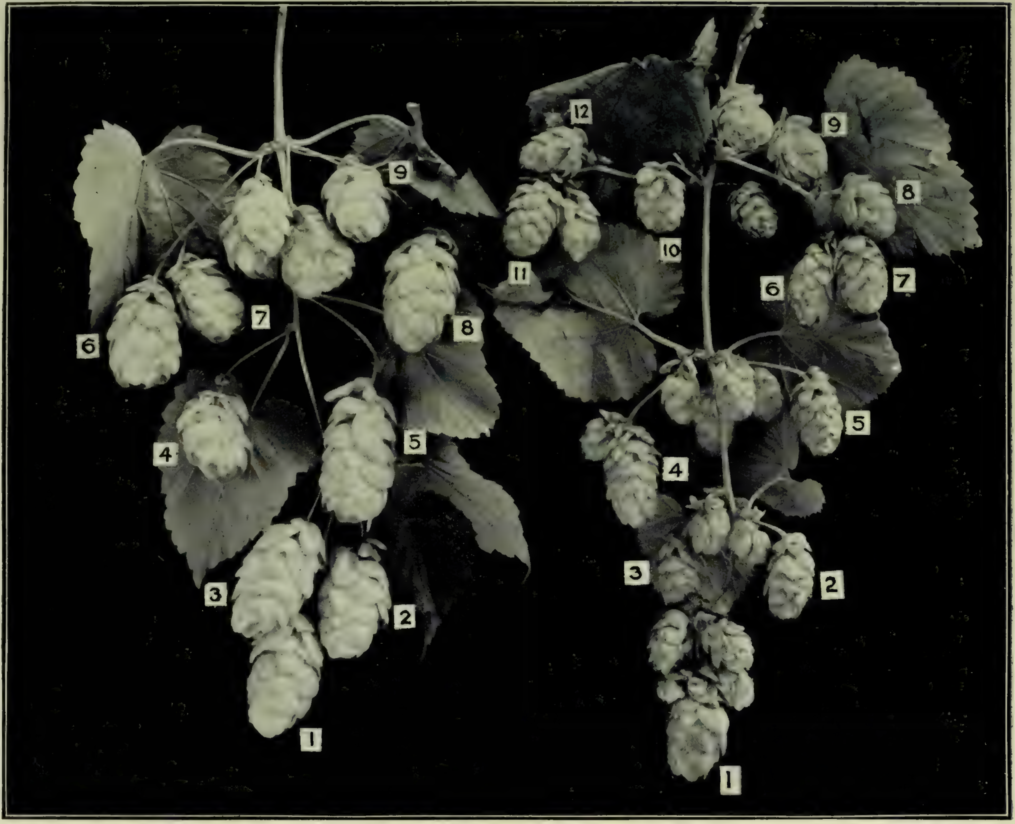
* *Journal* S.E. Agricultural College, vol. xvii., p. 383 (1908).

## TABLE 1.—ENGLISH HOPS.

### GOLDINGS.

| District. | Variety. | Remarks. | Av. No. of Bracteoles per Hop. | Av. Length of Hop in Inches. | Ratio of Seeded to Seedless Bracteoles. | Av. No. of Seeds per Hop. |
|---|---|---|---|---|---|---|
| 1906 | | | | | | |
| 1 Wye .. | Canterbury Whitebines | Not grown out; very poor crop | 27 | $\frac{9}{10}$ | 10 to 233 | 1.1 |
| 2 Wye .. | Early Bird .. | Not grown out .. | 27 | $1\frac{1}{10}$ | 10 to 54 | 4.2 |
| 3 Faversham .. | Goldings .. | Medium .. | 27 | $1\frac{3}{10}$ | 10 to 44 | 5.0 |
| 4 Faversham .. | Goldings .. | Medium .. | 28 | $1\frac{2}{10}$ | 10 to 41 | 5.6 |
| 5 Wye .. | Goldings .. | Medium .. | 27 | $1\frac{1}{10}$ | 10 to 40 | 5.6 |
| 6 Petham .. | Petham Golding .. | Hops grown out .. | 27 | $1\frac{2}{10}$ | 10 to 25 | 7.9 |
| 7 Wye .. | Goldings .. | Selected hops; 2 in. long or over | 53 | $2\frac{1}{10}$ | 10 to 16 | 20.3 |
| 8 Faversham .. | Mercer's Golding .. | Hops well grown out .. | 25 | $1\frac{2}{10}$ | 10 to 15 | 9.9 |
| 9 Faversham .. | Goldings .. | Hops well grown out .. | 26 | $1\frac{5}{10}$ | 10 to 12 | 11.4 |
| 10 Faversham .. | Mathon .. | Hops well grown out .. | 28 | $1\frac{3}{10}$ | 10 to 10 | 14.2 |
| 11 Puttenham .. | Farnham Whitebine .. | Selected branch of large hops .. | 26 | $1\frac{7}{10}$ | 10 to 5 | 18.2 |
| 1907 | | | | | | |
| 12 Wye .. | Goldings .. | Not grown out .. | 28 | $\frac{7}{10}$ | 10 to 495 | .5 |
| 13 Wye .. | Goldings .. | Not grown out .. | 28 | 1 | 10 to 137 | 1.9 |
| 14 Maidstone .. | Goldings .. | Hops small .. | 23 | $\frac{8}{10}$ | 10 to 77 | 2.6 |
| 15 Maidstone .. | Goldings .. | Hops grown out .. | 33 | $1\frac{4}{10}$ | 10 to 26 | 9.2 |
| 16 Chilham .. | Goldings .. | Hops well grown out .. | 33 | $1\frac{3}{10}$ | 10 to 23 | 10.0 |
| 17 Wye .. | Goldings .. | Hops grown out .. | 33 | $1\frac{3}{10}$ | 10 to 25 | 9.4 |
| 18 Wingham .. | Bramblings .. | Badly grown out .. | 20 | $\frac{8}{10}$ | 10 to 21 | 6.6 |
| 19 Faversham .. | Bramblings .. | Small to medium .. | 24 | 1 | 10 to 19 | 8.2 |
| 20 Wye .. | Goldings .. | Hops grown out .. | 27 | $1\frac{1}{10}$ | 10 to 18 | 9.7 |
| 21 Wingham .. | Bramblings .. | Medium .. | 25 | 1 | 10 to 16 | 9.6 |
| 22 Farnham .. | Farnham Whitebine .. | Hops well grown out .. | 30 | $1\frac{3}{10}$ | 10 to 15 | 12.0 |
| 23 Bodiam .. | Mathon .. | Hops well grown out .. | 28 | $1\frac{2}{10}$ | 10 to 14 | 11.4 |
| 24 Farnham .. | Farnham Whitebine .. | One of the best gardens of year .. | 35 | $1\frac{4}{10}$ | 10 to 9 | 18.8 |
| 25 Puttenham .. | Farnham Whitebine .. | Hops well grown out .. | 28 | $1\frac{3}{10}$ | 10 to 5 | 18.6 |
| 1908 | | | | | | |
| 26 Wye .. | Canterbury Whitebine | Not grown out .. | 27 | 1 | 10 to 100 | 2.5 |
| 27 Wye .. | Canterbury Whitebine | Medium to good .. | 29 | $1\frac{2}{10}$ | 10 to 30 | 7.2 |
| 28 Wye .. | Canterbury Whitebine | Well grown out .. | 30 | $1\frac{2}{10}$ | 10 to 19 | 10.2 |
| 1909 | | | | | | |
| 29 Wye .. | Canterbury Whitebine | Well grown out .. | 29 | $1\frac{2}{10}$ | 10 to 11 | 13.6 |

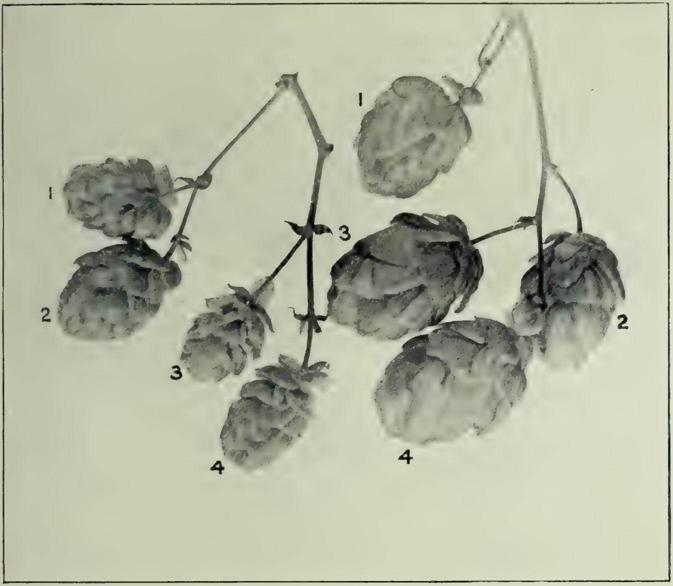
PLATE I.



[W. H. Hammond, *photo.*

Photograph of two branches (*on the same scale*) of the " Early Bird " hop ; the one to the left had been fertilised by a male hop, and the hops have " grown out," the one to the right had not been fertilised, and the hops have consequently not " grown out." (For explanation of numbers, see p. 339).

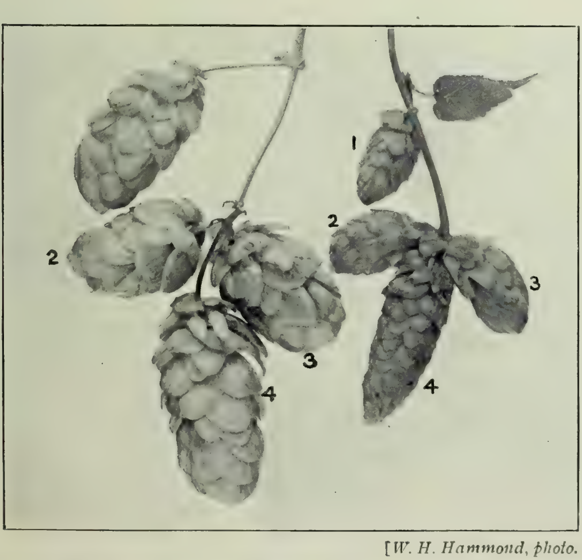
PLATE 2.



[*W. H. Hammond, photo.*

Photograph of two branches, each bearing four hops (*on the same scale*); the hops to the right are seeded and "grown out," those to the left are "seedless" and not "grown out." (For explanation of numbers, see p. 342).

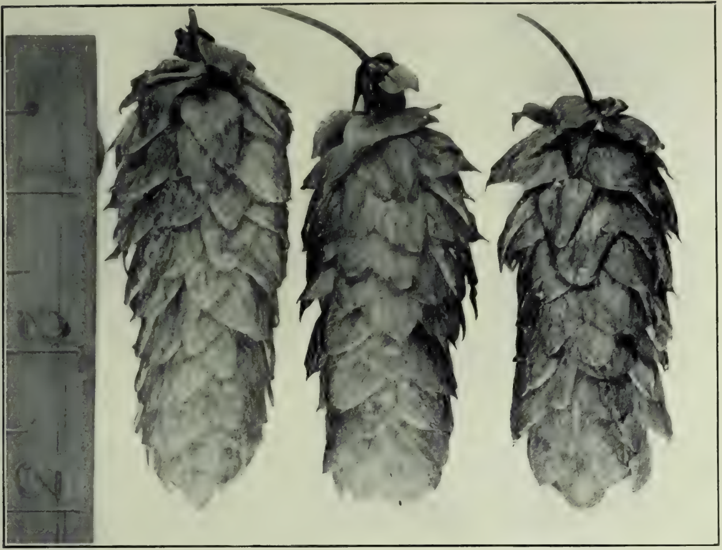
PLATE 3.



[*W. H. Hammond, photo.*

Photograph of two branches, each bearing four hops (*on the same scale*); the hops to the left are seeded and "grown out," those to the right are seedless and not "grown out." (For explanation of numbers, see p. 343).

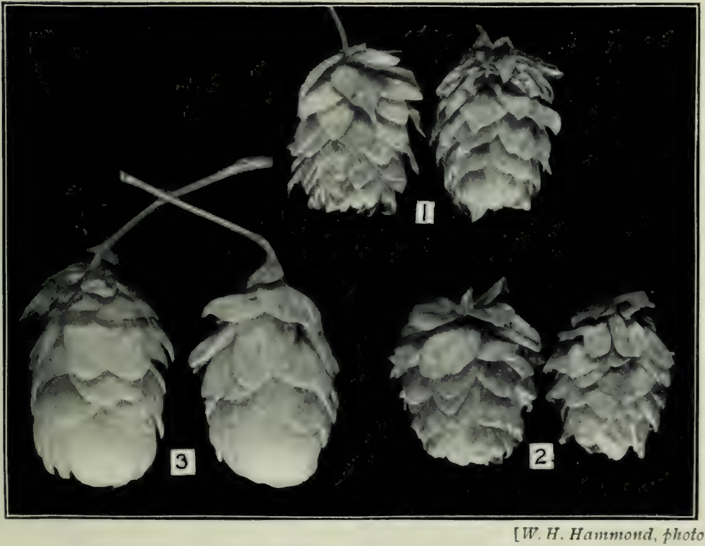
PLATE 4.



[*W. H. Hammond, photo.*

Photograph of three hops from a "seedling," raised by crossing a Bavarian (Saaz) variety of hop with pollen from an English male hop.

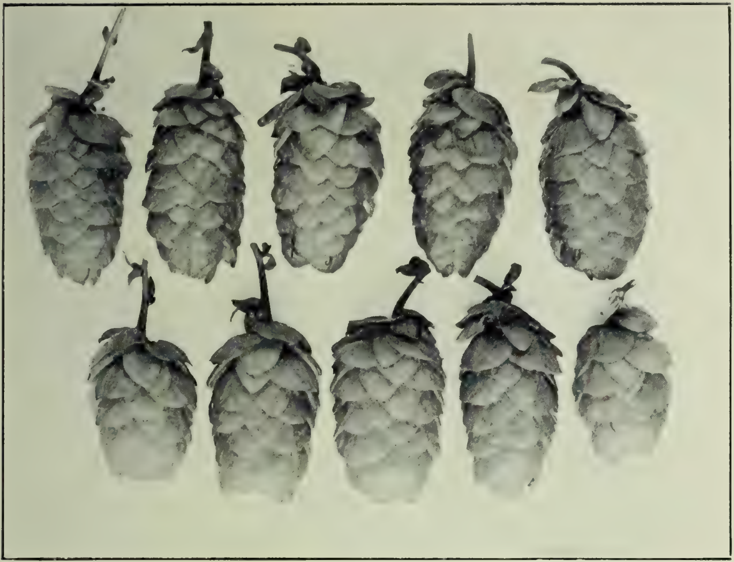
PLATE 5



[*W. H. Hammond, photo.*

1. "SEEDLESS" HALLERTAU HOPS, from Germany (see p. 349).
2. "SEEDLESS" GOLDING HOPS, from Germany (see p. 349).
3. "SEEDED" GOLDING HOPS, Kent (see p. 349).

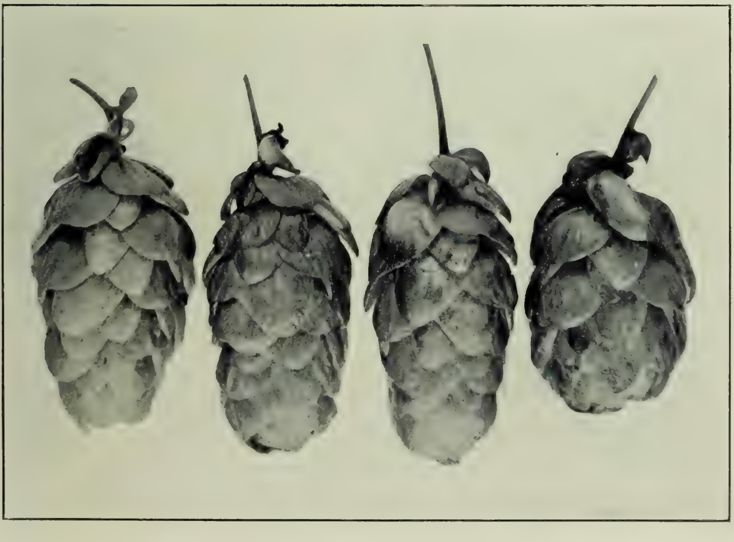
Plate 6.



[W. H. Hammond, photo.

"Seedless" Golding Hops (see p. 349). *Natural size.*

Plate 7.



"Seeded" Golding Hops (see p. 349). *Natural size.*

## TABLE 2.—ENGLISH HOPS,

### COBB'S GOLDING; FUGGLES; "WILD" HOPS.

| District. | Variety. | Remarks. | Av. No. of Bracteoles per Hop. | Av. Length of Hop in Inches. | Ratio of Seeded to Seedless Bracteoles. | Av. No. of Seeds per Hop. |
|---|---|---|---|---|---|---|
| 1906 | | | | | | |
| 1 Bodiam .. | Cobb's Golding .. | Not grown out .. | 26 | 1 | 10 to 128 | 1.9 |
| 2 Ashford .. | Cobb's Golding .. | Moderately grown out .. | 26 | $1\frac{2}{10}$ | 10 to 35 | 5.8 |
| 3 Selling .. | Cobb's Golding .. | Grown out .. | 22 | $1\frac{2}{10}$ | 10 to 25 | 6.3 |
| 4 Ashford .. | Cobb's Golding .. | Large selected hops .. | 44 | 2 | 10 to 10 | 22.2 |
| 1907 | | | | | | |
| 5 Sheldwich .. | Cobb's Golding .. | Not grown out .. | 23 | 1 | 10 to 72 | 2.8 |
| 6 Teynham .. | Cobb's Golding .. | Not grown out .. | 28 | 1 | 10 to 71 | 3.5 |
| 7 Bodiam .. | Cobb's Golding .. | Medium .. | 25 | $1\frac{1}{10}$ | 10 to 21 | 8.2 |
| 8 Teynham .. | Cobb's Golding .. | Very well grown out .. | 35 | $1\frac{5}{10}$ | 10 to 11 | 16.5 |
| 1906 | | | | | | |
| 9 Puttenham .. | Fuggles .. | Selected, well grown out hops .. | 30 | $1\frac{4}{10}$ | 10 to 86 | 3.0 |
| 10 Bodiam .. | Fuggles .. | Selected, well grown out hops .. | 35 | $1\frac{7}{10}$ | 10 to 15 | 14.0 |
| 11 Ashford .. | Fuggles .. | Well grown out .. | 24 | $1\frac{4}{10}$ | 10 to 3 | 19.0 |
| 1907 | | | | | | |
| 12 Puttenham .. | Fuggles .. | Not grown out .. | 19 | $\frac{8}{10}$ | 10 to 44 | 3.5 |
| 13 Goudhurst .. | Fuggles .. | Well grown out .. | 26 | $1\frac{2}{10}$ | 10 to 18 | 9.2 |
| 14 Farnham .. | Fuggles .. | Well grown out; one of best gardens of the year .. | 23 | $1\frac{2}{10}$ | 10 to 15 | 8.9 |
| 15 Worcestershire | Fuggles .. | Not well grown out .. | 22 | 1 | 10 to 13 | 9.8 |
| 16 Worcestershire | Fuggles .. | Well grown out .. | 33 | $1\frac{4}{10}$ | 10 to 13 | 14.2 |
| 17 Bodiam .. | Fuggles .. | Well grown out .. | 24 | $1\frac{3}{10}$ | 10 to 8 | 13.2 |
| 18 Puttenham | Fuggles .. | Well grown out .. | 23 | $1\frac{3}{10}$ | 10 to 6 | 13.7 |
| 1906 | | | | | | |
| 19 Wye .. | "Wild" hops (cultiv'd) | Medium .. | 23 | 1 | 10 to 7 | 13.0 |
| 20 Chilham .. | Wild hop in hedgerow | | 21 | 1 | 10 to 1 | 18.6 |

TABLE 3.—GERMAN HOPS.

| Description. | Av. No. of Bracteoles per Hop. | Av. Length of Hop in Inches. | Ratio of Seeded to Seed'ess Bracteoles. | Av. No. of Seeds per Hop. |
|---|---|---|---|---|
| Sample 1 Bavarian .. | 49 | $1\frac{1}{10}$ | 10 to 600 | .8 |
| ,, 2 Unspecified German variety (from "low class" ground) .. | 28 | $\frac{7}{10}$ | 10 to 7040 | .2 |
| ,, 3 Hallertau .. | 54 | $1\frac{2}{10}$ | 10 to 1091 | .3 |
| ,, 4 Hersbrucker .. | 33 | $1\frac{2}{10}$ | 10 to 50 | 5.3 |
| ,, 5 Striesselspalter .. | 35 | $1\frac{1}{10}$ | 10 to 350 | 1.0 |
| ,, 6 Hallertau (Marzill) .. | 38 | $1\frac{1}{10}$ | 10 to 120 | 2.9 |
| ,, 7 Goldings (English) grown in Germany .. | 35 | $1\frac{1}{10}$ | 10 to 310 | 1.1 |
| ,, 8 Prakenhelser .. | 33 | $1\frac{1}{10}$ | 10 to 60 | 4.9 |

Contrast this, finally, with Sample No. 7, where with an average of only twenty-five bracteoles per hop, the length of the hop reaches $1\frac{1}{10}$ in., because each hop contains on an average 8.2 seeds.

In the case of Fuggles it is often the same, though here, if the number of bracteoles per hop is sufficiently large, *well grown out hops which are nearly seedless con be produced.* In Sample No. 9 of Fuggles (see Table 2), from Puttenham, Surrey, the hops showed an average of thirty bracteoles per hop, with an average length of $1\frac{4}{10}$ in., although possessing only three seeds per hop. Although the effect of seed production in increasing the size of the hop is not apparently so marked in Fuggles as it is in Goldings (including Cobb's Golding) it is still noticeable. Turning to Table 2, we find that in Sample No. 13, where the average number of bracteoles per hop is twenty-six, the average length of the hop is $1\frac{2}{10}$ in.,—here the number of seeds per hop is 9 2 ; in Samples Nos. 17 and 18, with the average number of bracteoles per hop only twenty-four and twenty-three respectively, the average length of the hop has increased to $1\frac{3}{10}$ in., due to increased seed production (13.2 and 13.7 seeds per hop). Finally, in Sample No. 11 we find that the production of nineteen seeds per hop, with an average of only twenty-four bracteoles per hop, results in a hop averaging $1\frac{4}{10}$ in. in length.

Investigations into the question of the market value of "seeded" and "seedless" Fuggles require to be made. Under certain conditions it may be possible to grow *large nearly seedless Fuggles hops*, while in our experience no large, *i.e.*, properly grown-out, Golding hops can be grown without containing seed to the extent shown in the grown out samples given in Table 1. The correct treatment of gardens of Fuggles may therefore be different from that of Golding gardens.

The effect of the production of seed in increasing the size of the hop can be seen very strikingly in the case of Samples Nos. 20 and 21 (in Table 2), which consisted of "wild" hops—in one case cultivated in a hop garden, in the other growing in a hedge. Here, with only twenty-three and twenty-one bracteoles per hop respectively, an average length per hop of 1 in. was attained, by means of the production, respectively, of no less than 13 or 18.6 seeds per hop. These may be contrasted with Samples Nos. 1 and 12 in Table 1, where, with the number of bracteoles per hop increased to twenty-seven or twenty-eight, the length of the hop reached only $\frac{9}{10}$ or $\frac{7}{10}$ respectively, due to the amount of seed sinking to 1.1 or .5 seeds per hop.

*Conclusion.* The greater the number of "petals" per hop—a character dependent apparently not only on the particular variety of hop grown, but also on conditions of soil, cultivation and season,—the less need there is of the presence of seed in order to obtain the "growing out" of the hop. It is so seldom the case, however, with English hops that the number of "petals" per hop is sufficient to allow the grower to grow "seedless" hops that the supply of male hops in a garden must be looked upon as a point of primary importance.

## 4. On the raising of new varieties of hops from seeds.

The work of "crossing" different varieties of hops with pollen from males of various types has been continued, 3303 seeds being obtained in 1908. The female parents used were Prolifics, Canterbury Whitebine, a wild hop with good aroma, a German variety ("Stirn"), and three hops of seedling origin.

We have now in the College hop "nursery" a good stock of seedling hops of different parentage; many of these are now available for trial by growers. Hops from the most promising of these seedlings have been dried and submitted (as box samples) to various hop factors and merchants for their opinion. In a number of cases a favourable verdict as to flavour has been given. Sets from eight of those seedlings which obtained the most favourable report are now being grown in the College hop-garden with the object of testing their cropping powers on a larger scale, and also of putting a sample in bulk on the market. We shall be pleased to give cuttings from any of the seedling hops now growing at the College to any hop-grower in Kent or Surrey. Some seedlings which have obtained a favourable report in the Borough as to their flavour, show a very strong growth, and should be tried experimentally by growers on ground where the ordinary varieties of hops become attacked badly by eelworm or "canker," as some of these seedlings are likely to possess powers of resistance if not actual immunity to these diseases. One or two hop-growers are already about to plant up a few hills experimentally with certain of the College seedlings. As it is most desirable to get the promising seedlings (of which we hope to have an increasing number each year) tested on the various hop soils of Kent and Surrey, the invitation is here given to growers to visit the College "nursery" next season, and indicate any "hill" from which they would like to have "cuttings."

# VETERINARY NOTES.

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# VETERINARY NOTES.

## DISEASES OF SHEEP.

### I.—"STRUCK" SHEEP EXPERIMENTS, 1902-9.

During the past seven years continuous efforts have been made to discover a successful method of preventive treatment for the disease known as "Struck." In this time nearly 1,600 experiments have been tried on animals. It is now hoped that a safe preventive treatment has been found.

As is well-known the disease "Struck" causes great mortality among sheep during the spring months, especially in the Romney Marsh district of Kent.

Very early in the investigation the disease was found to be of microbic origin. It could also be readily communicated to a healthy animal by inoculation.

The bacillus, which was always present in the diseased flesh of a "struck" sheep, was found to closely resemble the bacillus of "Black-quarter," a well-known disease of cattle for which protective inoculations have been successfully used.

The post-mortem appearances of a "struck" sheep were found to closely resemble those seen in Black-quarter of cattle.

As there was this similarity between the two diseases, and as the micro-organisms seemed to be identical, it was hoped that the same preventive inoculations, which were being successfully used for Black-quarter in cattle, would prove successful in protecting sheep against "Struck."

An extensive trial of vaccination or protective inoculation was carried out on sheep during 1903-4, but the vaccines used for cattle were found to be highly dangerous for sheep, and a considerable loss among the experimental sheep resulted;—a loss which was directly due to the inoculations.

This method was then abandoned as unsafe, although it was clearly shown by these experiments that those sheep which passed safely through the inoculations were protected against "Struck." In one experiment there was only one death out of forty vaccinated sheep, while out of fifty unvaccinated sheep nine were struck; a saving of 15½ per cent.

My attention was then called to the experiments carried out by the late Professor Hamilton, of the University of Aberdeen, for the prevention of "Braxy" in sheep.

In the reports of these experiments, published by the Board of Agriculture in 1906, it was shown that "Braxy" could be prevented by dosing sheep with pure and virulent cultures of the "Braxy" bacillus, these doses being given shortly before the "Braxy" season of the year commenced.

I determined to try whether any good result would follow the dosing of sheep with pure cultures of the "struck" bacillus.

It will be convenient here to explain the theory upon which this preventive method is based.

As is well-known, "Struck" occurs at one particular season of the year, generally during March, April and May, although there is a slight variation of the season in different years. At this season sheep are highly susceptible to the "struck" bacillus, and it is to this fact we owe the origin of the popular idea that the disease is due to the growth of young grass in the spring.

Whether the young grass has any part in rendering the sheep more susceptible at this season is not known, but it is certain that the disease is due to the "struck" bacillus, and it is necessary to look for another explanation of its regular appearance in the spring. The bacilli of "Struck," or their spores, are present in the soil of dangerous pastures, and in all probability sheep may take in the germs with the grass at all seasons of the year, yet the disease occurs chiefly in the spring.

The explanation of this fact is, that during the greater part of the year the blood of sheep possesses a high power of resistance, and is capable of destroying the bacilli, so that no harm is caused by the entrance of the germs into the body. But in the spring the blood loses this power of resistance, and is unable to stop the invasion of the bacilli, and the disease occurs. Why, then, do any sheep, grazing on dangerous ground, escape being struck in the spring ? For one may assume that all sheep living on dangerous ground are more or less exposed to the entrance of the bacilli into their bodies.

It is suggested that sheep which are grazing on dangerous pasture during the whole year will gradually become immunised by the frequent doses of the bacilli which they swallow and are thus able to resist the disease in the spring, while those sheep die which have not previously been immunised during the safe part of the year. If all the sheep have acquired this immunity none will die in the spring. If then we can make certain that every sheep has received a dose of the "struck" bacilli shortly before the dangerous season begins, we may hope they will be sufficiently immunised against the disease to live safely through the dangerous months.

To ensure that sheep shall receive a dose of the "struck" bacilli at a safe period of the year one must drench the sheep with suitable quantities of the living microbes, which have been cultivated artificially in the laboratory.

For some time preliminary experiments were carried on in the laboratory and at the College farm, and then a series of field experiments was planned for the early part of 1908.

These experiments were carried out in Romney Marsh on sheep provided for the purpose by Mr. A. Finn, of Lydd.

During January, 1908, 255 sheep were each given two doses of the prepared culture. The second dose was given a fortnight after the first. No ill-effect was caused by the doses, which were given out in the open Marsh, while the sheep were exposed to all varieties of winter weather.

In the following July the records kept by the shepherds clearly showed that the treated sheep were protected against "Struck" for a period of *two months* after the administration of the second dose was completed. During these two months not a single treated sheep died from "Struck," while fourteen of the untreated animals died from that disease. Unfortunately the immunity did not last sufficiently long to carry the sheep safely through the *whole* of the dangerous season.

From the facts shown by these experiments, I formed the conclusion that a more prolonged immunity might possibly be given to the sheep—an immunity which would protect them during the most dangerous spring months, March, April and May :—

(*a*) If the doses were given at a later period and nearer to the dangerous season,

(*b*) and if larger doses of the culture could be safely administered.

Arrangements were then made for a fresh trial to be carried out in February of this year. Mr. A. Finn again provided sheep for the experiment.

One hundred and ninety sheep received three doses of virulent culture between the end of January and the end of February. The third dose was given on February 25th, or five weeks later than the last dose in the preceding year. The total dose given to each sheep was also greatly increased. The 190 treated sheep were carefully marked and kept on land known to be dangerous, and 190 untreated sheep were put on the same ground as control animals. Careful records of deaths from "Struck" in the two lots have been kept by the shepherd up to the end of June. These records have now been examined, and although the mortality due to "Struck" has been unusually light during the past season, the figures confirm, as far as they go, the results obtained in 1908.

Of the treated sheep one died from "Struck" on March 29th, this being the only case among the marked sheep until the close of the experiment. Of the untreated sheep, four are shown to have died from the disease.

Unfortunately for my experiments the past spring has not proved so dangerous to sheep as is commonly the case, but the records clearly show that the treatment has been beneficial; the number of sheep "struck" in the untreated lot being four times greater than in the treated sheep.

When the records of the experiments in the two years, 1908 and 1909, are considered together it may be seen that out of 445 treated sheep only *one* died during the first two months following the treatment, while in the untreated lot, pastured on the same ground, there were *sixteen* deaths from "Struck" in the same period.

I think there can be no doubt that the method of dosing sheep with living cultures of the " struck " bacillus just before the dangerous season begins, may give sufficient immunity to, at least, considerably diminish the loss which usually occurs during each spring.

In these experiments I have personally administered eleven hundred doses *without a single fatality*, so that the method may be regarded as a safe one, but its value can only be fully proved or disproved by treating a much greater number of sheep than has hitherto been possible.

I think the time has now arrived when it is possible to offer the method of treatment to the sheep-owners as one worthy of an extensive trial.

I hope that sheep-owners will be willing to try the treatment on their sheep during next winter, and that a sufficiently large number of animals may undergo the treatment as will thoroughly test its value.

In conclusion, I have again to offer Mr. Arthur Finn my very sincere thanks for his much valued assistance in my experiments. I am also indebted to Mr. Macintosh and to Mr. Carlisle for their help in dosing the sheep.

## II.—PREVENTION OF PARASITIC DISEASES OF SHEEP.

That some treatment for the prevention of parasitic diseases of sheep, and particularly of lambs, is necessary no one can doubt.

During every part of their first year of existence, lambs are constantly exposed to the attacks of the various parasites, which cause such terrible losses among our flocks annually.

I am constantly receiving reports of the ravages caused by parasites among lambs under one year old, but it is impossible to estimate the number of deaths, although it must be very large.

I am convinced that a good deal of this annual loss could be prevented if suitable precautions were taken at the *right* season for the particular parasite concerned. In this district much of the disease in lambs is due to the fact that they are reared on old and sheep-soiled pastures, in which the various parasites have accumulated to a dangerous degree, and either some change must be made in the management of the flock, which will ensure lambs being kept off dangerous pastures, or some form of preventive treatment must be adopted. In many parts of this country it is now recognised that much parasitic disease may be prevented by a careful provision of fresh crops on which lambs may be reared during their first year of life.

In Kent, and in many other sheep-breeding districts the sheep population is very dense, and lambs are of necessity frequently kept on old and sheep-soiled pastures, and to this fact much of the mortality amongst our lambs must be attributed.

It is almost impossible to hope that any change will be made in the method of management in such districts, and it becomes necessary to discover some means whereby lambs, although living in dangerous localities, may yet be protected as far as possible from their parasitic foes.

Improvement in the condition of these old sheep-soiled pastures would undoubtedly follow if sheep could be kept off them for two or three years, but such a method is generally impracticable. Some alleviation of the trouble might be obtained by occasionally cropping the land for hay, and so giving it a rest for a few months.

Top dressing of the land with salt, lime, nitrate of soda, or old gas lime, etc., has been frequently recommended, but I have found it difficult to persuade the sheep-owner to adopt such methods, owing to their cost. At the same time I must say that where grass land has been dressed with salt, etc., a decrease in the mortality from parasitic diseases has followed. Whenever possible the number of sheep per acre should be reduced. Such methods as these will, however, require time to be effective, and it is therefore necessary that other steps should be taken to lessen the danger of rearing lambs on these old pastures.

For many years I have recommended the use of salt, or salt and sulphate of iron, as a preventive remedy against these parasitic diseases.

Common salt has been used for a still longer period, and the idea seems to have originated in the fact that sheep living on salt marshes were found to be less troubled with parasites than those living on pastures where salt was not present.

The method generally adopted for the administration of salt to sheep is to place about the pasture large pieces of rock-salt or prepared rolls of common salt, with the expectation that as sheep are fond of salt, they will frequently lick it.

This method is quite uncertain. It is impossible to estimate the amount of salt consumed by each sheep, or how frequently each sheep takes a voluntary dose.

I have, therefore, advocated the administration of daily small doses of common salt and sulphate of iron, mixed with a sufficient amount of nutritious dry food. By this method one can make sure that each sheep or lamb will consume a moderate dose of these drugs daily. It is, in my opinion, essential for the success of the preventive treatment that the salt and iron should be taken regularly day by day, a result which cannot be ensured by the ordinary method of administration by salt-licks. The presence of a small quantity of common salt and sulphate of iron in the alimentary canal may not destroy the parasites which have entered by the mouth, but their presence may be sufficient to prevent the parasites from remaining in the body, so that they will pass harmlessly through the alimentary canal.

It is on these lines that I believe much good might be done by the systematic use of salt at the proper season of the year. Lambs, during their first year, are liable to diseases caused by several different parasites, and it will be convenient to consider the suitable preventive treatment for each disease in the order in which the diseases occur.

*Tapeworm Disease.*—Lambs during May and June are frequently found to be suffering from this disease, and in certain low lying districts heavy losses are experienced annually. In wet seasons the disease often makes its appearance in localities which are usually free from it.

I have already given an account of the tapeworm (*Moniezia expansa*) in a former Journal, and need not repeat that account.

Experiments have been tried for some years, and good results have been obtained from the regular administration of common salt and sulphate of iron, mixed with dry food, to lambs which are living on known dangerous ground. The following formula has been used :—

| | | | |
|---|---|---|---|
| Finely | ground | Linseed Cake | 1 bushel of each. |
| ,, | ,, | Pea-meal | |
| ,, | ,, | Common Salt | 4-lb. |
| ,, | ,, | Aniseed | 4-lb. |
| ,, | ,, | Sulphate of iron | 1-lb. |

The cake and pea-meal should be mixed in one heap, and the salt, aniseed and iron in another heap, then the two lots should be thoroughly mixed so as to ensure the distribution of the salt and iron equally in the whole mass. From a quarter of a pint to half a-pint of this mixture may be given daily to each lamb, with any other dry food which can be conveniently provided.

The food containing the salt and iron should always be given in *covered* troughs, as wet renders the mixture unpalatable. Where there is reason to fear that lambs will suffer from tapeworm disease, the above mixture should be fed to the lambs as soon as they can be taught to eat dry food, and it should be given regularly until the end of July.

For many years various theories have been suggested to explain the way in which lambs get the young tapeworms, and it has even been suggested that they become infested during fœtal life, or later through the milk of the ewe. There is no reason to believe that either of these suggestions is correct, but there is every reason to believe that lambs pick up the young worms from the grass. I have lately tried the experiment of dosing a lot of in-lamb Kent ewes with vermifuge remedies in mid-winter. The reason for this experiment was the belief that the ewes are the constant hosts of the tapeworms, and that they distribute the eggs of the parasite over the pasture. In wet seasons or in damp, low-lying ground, the eggs hatch out and embryo worms escape and are picked up by the young lambs in large numbers. (In America it has been found that 87 per cent. of the sheep and lambs examined in one district were affected with tapeworm.)

As it is now thought that the lamb tapeworm can reach maturity in the lamb, without entering the body of any intermediate bearer, the suggestion that the ewes are the hosts of mature tapeworms and are constantly spreading the eggs about the pasture, is one well worthy of consideration. It will be seen that, if there is any truth in the above theory, the expulsion of the mature tapeworms from the ewes will help to prevent them from infecting their lambs when born later on in the spring. The result of dosing the ewes was so encouraging that further experiments are desirable. I would suggest that anyone who has experienced much trouble from tapeworm in his lambs should try the effect of dosing in-lamb ewes two or three times during the winter, this treatment to be followed by the administration of salt and iron to the lambs as early as possible.

*Parasitic Bronchitis*, or Husk, occurs in lambs during August, September and October. As is now well-known the disease is caused by the presence of Strongyles (*Eustrongylus filaria*) in the bronchial tubes of the lungs. These lung worms, as they are commonly called, breed in the bronchial tubes at an enormous rate, and the adult worms and the young brood together cause intense irritation to the lining membrane of the tubes, hence the Bronchitis. The young worms or embryos cannot reach maturity in the lungs of the same lamb, and are coughed up with mucus and expelled on to the ground. In moist ground or soft mud or in water, the worms increase in size and probably enter the bodies of some small creatures which live in moist situations. Later the worms must leave these intermediate hosts, and lie in the grass or in water awaiting the time when they will be picked up by the next season's lambs.

When the young worms are picked up with the grass, they are swallowed by the lambs and so reach the stomach. How they pass from the stomach to the lungs has not yet been determined, but on arriving at the lungs they soon reach maturity, and in their turn begin to breed in the bronchial tubes.

The disease, as is well-known, is difficult to treat, and frequently is the cause of a heavy mortality. It is therefore necessary to adopt some preventive treatment in the hope of protecting the lambs from the invasion of the parasite.

In this disease I have found the administration of the salt and iron mixture to be most useful when applied at the proper season. Where there is reason to fear that lambs may suffer in the autumn from Husk, the preventive treatment *must* be begun in May and carried on during June and July. It is during these months that the lambs take up the young worms from the pasture, although the symptoms of husk do not appear until August, September or October.

I have known much disappointment from the failure of salt to protect the lambs from the invasion of the parasite, because the salt has been given too late, and after the worms have left the stomach, and have reached or are on their way to the lungs. It is then hopeless to adopt any preventive treatment.

From my own experience I am satisfied that Husk can be prevented if salt and iron are administered at the right season, *i.e.*, during May, June and July.

Where practicable other preventive methods may be adopted. Lambs may be provided with fresh crops, grown on unsoiled ground, so that the invasion by the lung worm need not be feared, but where this is impossible the administration of salt and iron should always be tried.

*Parasitic Gastritis.* Lincolnshire lamb disease, stomach worm.

There is every reason to believe that heavy losses are being experienced this year from the ravages of the various kinds of worms which inhabit the fourth stomach of lambs. The worms principally concerned in this dangerous malady are *Strongylus contortus* and *Strongylus cervicornis.* The former, *Strongylus contortus*, is a comparatively large worm, yet it is difficult to detect in the thick muddy contents of the stomach. It is present in enormous numbers, and clings to the mucous membrane, from which it sucks blood. I have seen the contents of the stomach, when examined immediately after death, in a state of agitation, as if the liquid were boiling, this appearance being due to the active movements of the immense number of worms.

The latter, *Strongylus cervicornis*, is a small delicate worm, which is still more difficult to detect in the contents of the stomach.

The best method for examining the contents of the stomach, in suspected cases, is to pour the contents into a glass jar, and to draw a long needle slowly through the liquid. The needle is then washed in water in a glass jar. If the worms are present in the stomach they will be entangled on the needle and will be washed off in the clear water, and can then be readily seen.

Lambs affected with these parasites do not unfortunately show any marked symptoms of illness until the later stages of the malady are reached. The chief symptoms will then be rapid emaciation and diarrhœa. The disease is difficult to treat when diarrhœa and emaciation have set in, and heavy losses are generally experienced.

It is not, in my opinion, difficult to bring about the expulsion of the parasites. This may be done by the administration of suitable vermifuge remedies, which should be prescribed by the veterinary surgeon. But, although the worms may be expelled, the lambs are frequently too exhausted to rally, and death occurs in spite of the treatment. It will be again useful to emphasise the importance of an early diagnosis of the true nature of the illness.

Frequently one or two deaths occur at first, and no proper post-mortem examination being made, the presence of the worms is not suspected. Later the lambs begin to die in large numbers and the total loss is very heavy. If, however, the presence of the worms in the stomachs of the first cases is detected, much loss may be saved by immediately putting the whole flock under the treatment of the veterinary surgeon.

Where an outbreak of this disease occurs the ground is rapidly soiled by the eggs and young worms which escape from the affected lambs, and a pasture so contaminated will be highly dangerous to lambs in the following season. It would be a good policy to dress such a pasture during the following winter or early spring with common salt, etc., or if possible to keep sheep off the land for a time, and the pasture can also be laid down for hay.

I have also recommended the use of salt and iron for lambs which are reared on soiled ground, and, provided that the administration is regular and continuous from weaning time, I believe the treatment has proved valuable.

*Pothery, Gid, Sturdy.*—Lambs from eight to twelve months old are liable to develop symptoms of pothery, especially in wet seasons. As is now well-known, the eggs of the tapeworm (*Tœnia cœnurus*) are scattered on the land by dogs which harbour these worms, and frequently by dogs which work among sheep.

The eggs can live in moist ground, and when eaten by lambs, cause the development of the gid hydatid in the brain. As the hydatids increase in size, symptoms commonly known as pothery or gid are produced, and ultimately heavy losses may result.

The life history of the tapeworm and the true nature of the gid hydatid has been known for many years, yet the natural and simple methods of prevention are frequently ignored, if not by the sheep breeder, at any rate, by the shepherds. Destroy all the heads of pothery lambs, do not give them to the dogs to devour, and keep your sheep dogs free from tapeworm, and there will be very little risk of trouble and loss from this disease.

# THE PREVENTION OF LAMB DISEASES.

## A SYSTEM OF CROPPING FOR PROVIDING GREEN FOOD FOR LAMBS.

By B. N. Wale, B.Sc. (Agric.).

As is well-known, lambs suffer greatly from internal parasitic diseases during their first year. The parasites causing such diseases are found on the grass and surface soil, especially of certain old pastures, and are easily taken in by the animal when grazing. Serious damage is not often done to sheep more than a year old : it is to sheep under that age that attention will therefore be chiefly confined.

The eggs of the parasites are passed out with the dung in countless numbers by an infected sheep, and in this way what before may have been a clean pasture, becomes contaminated in a wholesale manner, so that in subsequent grazing it is almost impossible for a lamb to get a bite without taking in some of them.

When grass land has become infected in this way it is very unlikely that it will become free again unless very careful precautions are taken. It would appear, however, that if a contaminated pasture be kept perfectly free from sheep of all ages for a period of two or three years, it may become clean.

Let it be distinctly understood that the subsequent remarks apply *only* therefore to grass land which is already contaminated. The following information is based almost entirely on the practice of flockmasters in different parts of England, who by specific management keep their lambs free from such parasitic diseases.

At the outset a serious difficulty presents itself : the arable land farmer can easily be dealt with, but not so the grass land farmer. If the latter is to be *entirely successful,* very drastic measures will have to be adopted; and such measures may be considered almost impossible of being carried out.

One method would be to get rid of the sheep stock entirely for two or three years, and graze fatting bullocks or other stock in their place. In the cases already mentioned where flockmasters keep their lambs free from parasitic diseases, they rely very largely on the arable land on which they grow green crops for providing them with food during their first year, and so keep them off stale pastures entirely. This is almost impossible with the grazier whose land may be of such a nature that to convert it into arable would be injudicious, as for example, low-lying and badly-drained marshy land, or where the grass is so rich that it would be unwise to destroy so good a turf, to say nothing of difficulties that might arise between landlord and tenant. This, however, is only mentioned as a last resource. At the same time arable land can be made to grow a greater bulk of fodder than it would under grass; but this is suggested as an extreme alternative system on contaminated land.

A *sine qua non* in successful lamb rearing on such land is—*Never to allow the lambs to graze on the same land where they or older sheep have grazed before during the year, and never to graze the crop a second time over* unless a winter's frost or a hay crop has intervened, and on really tainted land it is wiser *never* to allow lambs to graze on the same crop a second time during the year. Once allow a second grazing on such land, no matter how careful and how good the subsequent feeding may be, the lambs will have picked up the parasites, and as sure as they are lambs they will begin to droop, dwindle away, scour and die.

In collecting together material for this paper I have been in correspondence with prominent sheep breeders all over England, and what they have found out as the result of long practical experience with regard to this lamb scourge should be particularly valuable at the present time. From the letters received I cull the following pertinent remarks:—

" In the spring and early summer old stale pastures should be especially avoided, particularly if they have been much sheep fed. If these pastures are fed the lambs are almost sure to get throat and lung worm, resulting in many cases in death, and in the others causing no end of trouble with much expense to get into condition again."

"Stale pasture is the chief cause of death to lambs."

"Fresh green diet is their salvation."

"The most needful thing in lamb grazing: Keep the lambs on clean, fresh ground. It is on stale pasture that lambs contract parasitic diseases."

"I have suffered from this myself from feeding tainted pastures, which now I always carefully avoid. So have many others, without knowing the cause."

To come to the question of providing fresh food for the lambs. To the sheep farmer who has up to now relied on his pastures for green food for his lambs, the forethought and foresight necessary to provide the same from other sources may appear somewhat appalling at the outset, but in time it resolves itself into a methodical system which really entails no serious trouble, except perhaps in the cases already instanced. On the one hand the system proposed will entail somewhat more labour, but on the other the dung is applied direct by the sheep, and without suffering any loss from the soluble matter being washed out by rain before it reaches the land, and all expense in carting out is saved. The number of the various crops suitable for the purpose is legion. Many of these are indicated in the subjoined table, but they are to be looked upon chiefly as a guide, and not as forming a complete list on the basis of which all systems of cropping for sheep are to be built. At the same time it is not expected that all the crops mentioned under a particular month will be grown on any one farm, probably two or at most three will suffice, but the full list allows of choice being made to suit individual tastes.

For want of a better name it is called the *Shepherd's Calendar*, as it is intended to show in what months of the year the crops are to be fed. It will be noticed also that in the middle column index numbers are used. These are inserted for the purpose of showing at a glance the different months of the year in which any particular crop may be made available for feeding. For example, 2 indicates kohl rabi, and this figure is found in the months of January, February, March, September, October, November and December, these being the principal months for which kohl rabi may be available for feeding if sown at the proper time. Again, 8 refers to vetches, and is found inserted for the months from April to October inclusive. The third column shows in what month seeding must take place, to provide food for the month indicated in the first column.

THE SHEPHERD'S CALENDAR.

| Month Fed. | Kind of Crop. | Month Sown. |
|---|---|---|
| JAN. | 1 Swedes<br>2 Kohl rabi (Late Big Top)<br>3 Mangels<br>4 Yellow Turnips<br>Broccoli<br>Savoys and Swedes | June.<br>May.<br>April and May.<br>June and July.<br>May, transplant June.<br>May and June (2 adjacent rows of each kind). |
| FEB. | 1 Swedes<br>2 Kohl rabi (Late Big Top)<br>3 Mangels<br>4 Turnips } Mixed<br>5 Rape } Mixed<br>Broccoli<br>Savoys and Swedes | June.<br>May.<br>April and May.<br>August and September.<br><br>May, transplant June.<br>May and June. |
| MAR. | 1 Swedes<br>2 Kohl rabi (Late Big Top)<br>3 Mangels<br>5 Rape<br>6 Kale<br>Savoys and Brussels Sprouts | June.<br>May and June.<br>April and May.<br>July and August.<br>March and April.<br>May and June. |
| APR. | 1 Swedes<br>3 Mangels<br>5 Rape<br>6 Kale<br>7 Clover and Sainfoin Leys<br>8 Rye and Vetches (Winter)<br>Rye<br>Italian Rye Grass (and Cocksfoot)<br>Winter Oats<br>Savoys and Brussels Sprouts | June.<br>April and May.<br>July and August.<br>July.<br>April and May.<br>August and September.<br>August.<br>Drilled in Wheat previous April, or after harvest in August.<br>September.<br>June and July. |

| Month Fed. | Kind of Crop. | Month Sown. |
|---|---|---|
| MAY. | 3 Mangels | April and May. |
| | 5 Rape | August and September. |
| | 6 Kale | August. |
| | 7 Clover and Sainfoin Leys | April. |
| | 8 Vetches (Winter) | August. |
| | 9 Cabbage (Early Enfield) | August, transplant October. |
| | Winter Barley | September. |
| | Winter Oats | September. |
| | Early Trifolium | August. |
| | Trefoil | April and May. |
| JUNE | 3 Mangels | April and May. |
| | 5 Rape (Dwarf) | March (this Rape may be left to sprout again, and could be fed to older sheep in September). |
| | 8 Vetches (Winter) | September. |
| | 8 Vetches<br>5 Rape } Mixed | September. |
| | 9 Cabbage (Enfield) | August, transplant October. |
| | 5 Rape<br>8 Vetches (Spring)<br>Oats (Winter) } Mixed | February. |
| | Late Trifolium | August and September. |
| JULY | 5 Rape (Giant) | April and May. |
| | 6 Kale | March. |
| | 7 Clover and other aftermaths | |
| | 8 Vetches (Winter) | October. |
| | 5 Rape<br>8 Vetches } Mixed | September and October. |
| | 8 Vetches<br>Winter Oats } Mixed | September and October. |
| | 9 Cabbage (Enfield) | August, transplanted October or February. |
| AUG. | 4 Turnips | April and May. |
| | 5 Rape (Giant) | May and June. |
| | 6 Kale | April. |
| | 7 Clover and other aftermaths | |
| | 8 Vetches (Spring) | February and March. |
| | 9 Cabbage (Drumhead) | October, transplant February. |

| Month Fed. | Kind of Crop. | Month Sown. |
|---|---|---|
| SEPT. | 2 Kohl rabi (Early Small Top) | April. |
| | 4 Turnips<br>5 Rape (Giant) } Mixed | May and June. |
| | 6 Kale | April. |
| | 8 Vetches (Spring) | March. |
| | 9 Cabbage (Drumhead) | October, transplant February. |
| | Corn stubble and new Clovers | |
| OCT. | 2 Kohl rabi (Early Small Top) | April. |
| | 4 Turnips | May and June. |
| | 5 Rape | July. |
| | 8 Vetches (Spring) | March. |
| | 9 Cabbage (Drumhead) | October, transplant March. |
| | Mustard | July and August. |
| | Maize | June. |
| NOV. | 2 Kohl rabi (Early Small Top) | May. |
| | 4 Turnips | June. |
| | 6 Kale | April. |
| | 9 Cabbage (Drumhead) | October, transplant March. |
| DEC. | 1 Swedes | June. |
| | 2 Kohl rabi (Early Small Top) | May. |
| | 3 Mangels | April and May. |
| | 4 Turnips | June. |
| | 9 Cabbages (Drumhead) | March, transplant June. |

The next table I name the *Cultivator's Calendar*, and just as the Shepherd's Calendar gives in chronological order the feeding of the crops, so the Cultivator's Calendar gives in chronological order the sowing of the various crops month by month to produce food at the time of the year mentioned in the first column of the Shepherd's Calendar, and also in the third column of the Calendar below.

## CULTIVATOR'S CALENDAR.

| Month Sown. | Kind of Crop. | Month Fed. |
|---|---|---|
| JAN. | None. | |
| FEB. | 5 Rape (Dwarf)<br>8 Vetches (Spring) Mixed<br>Oats (Winter) | June. |
| | 8 Vetches (Spring) | August. |
| | 9 Cabbage (Enfield & Drumhead) transplant | September. |
| MAR. | 5 Rape (Dwarf) | June. |
| | 6 Kale | March and July. |
| | 8 Vetches (Spring) | August, September and October. |
| | 9 Cabbage (Drumhead) transplant | October and November. |
| | Cabbage (Drumhead) sow | December. |
| APR. | 2 Kohl rabi (Early Small Top) | September and October. |
| | 3 Mangels | December to June. |
| | 4 Turnips | August. |
| | 5 Rape | July. |
| | 6 Kale | August, September and November. |
| | 7 Clover and Sainfoin Leys | April and May, July and August. |
| | Italian Rye Grass and Cocksfoot (in Wheat) | April. |
| | Trefoil | May (year hence). |
| MAY | 2 Kohl rabi (Early Small Top and Late Big Top) | November to March. |
| | 3 Mangels | December to June. |
| | 4 Turnips | August, September and October. |
| | 4 Turnips<br>5 Rape Mixed | September and October. |
| | 5 Rape | July, August & September. |
| | Clover and Sainfoin Leys | April and May, July and August. |
| | Broccoli (transplant June) | February. |
| | Savoys and Swedes (2 rows of each) | January and February. |
| | Savoys and Brussels Sprouts | March and April. |
| | Trefoil | May (year hence). |

| Month Sown. | Kind of Crop. | Month Fed. |
|---|---|---|
| JUNE | 1 Swedes | December to April. |
| | 2 Kohl rabi (Late Big Top) | January to March. |
| | 4 White Turnips | August to December. |
| | Yellow Turnips | January. |
| | 4 Rape<br>5 Turnips } Mixed | September. |
| | 5 Rape (Giant) | August and September. |
| | Savoys and Brussels Sprouts | March and April. |
| | Savoys and Swedes | January and February. |
| | Broccoli, transplant | January and February. |
| | Maize | October. |
| | 9 Cabbage (Drumhead) transplant | December. |
| JULY | 4 Yellow Turnips | January |
| | 5 Rape (Giant) | March and April. |
| | Rape (Dwarf) | October. |
| | 6 Kale | April. |
| | Savoys and Brussels Sprouts | April. |
| | Mustard | October. |
| AUG. | 4 Turnips<br>5 Rape } Mixed | February. |
| | 5 Rape | March, April and May. |
| | 6 Kale | May. |
| | Rye | April. |
| | Rye and Vetches | April. |
| | Italian Rye Grass | April. |
| | 8 Vetches (Winter) | May. |
| | 9 Cabbage (Enfield) transplant October | May, June and July. |
| | Early Trifolium | May. |
| | Late Trifolium | June. |
| | Mustard | October. |
| SEPT. | 4 Turnips<br>5 Rape } Mixed | February. |
| | Rye and Vetches | April. |
| | Winter Oats | April and May. |
| | 5 Rape | May. |
| | Winter Barley | May. |
| | 8 Vetches (Winter) | June. |
| | 7 Rape<br>8 Vetches } Mixed | June and July. |
| | Late Trifolium | June. |
| | Vetches and Winter Oats | July. |

| Month Sown. | Kind of Crop. | Month Fed. |
|---|---|---|
| OCT. | 8 Vetches (Winter) | July. |
| | 5 Rape<br>8 Vetches } Mixed | July. |
| | 8 Vetches<br>Winter Oats } Mixed | July. |
| | 9 Cabbage (Enfield) transplant | May and June. |
| | Cabbage (Drumhead) sow for transplanting Feb. & March | August to November. |
| NOV. | 8 Vetches (Winter) | August. |
| | 9 Cabbage (Enfield) transplant | June and July. |
| DEC. | None. | |

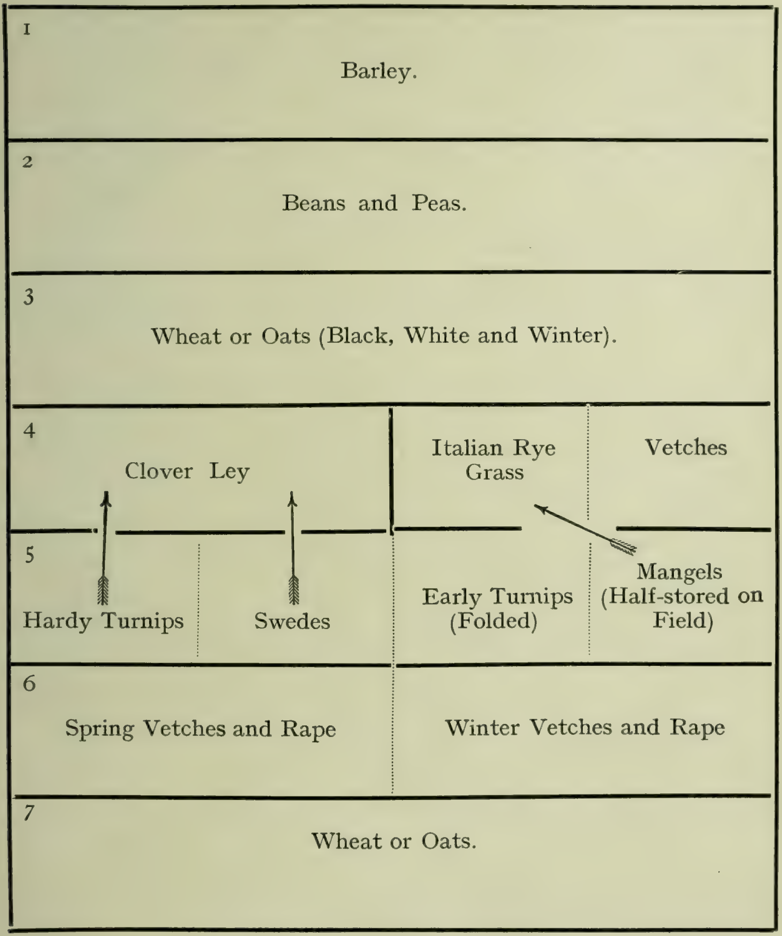
The difficulty of cropping for sheep is greater on the stiffer soils than on those of a lighter nature. With heavy land it is not permissible to fold sheep on roots during the winter months because of the damage to the land through poaching, and also because such land forms an uncomfortable lair for sheep in wet weather. To obviate either of these undesirable results, the old clover leys must remain unbroken until spring, part of them being folded before Christmas and the remainder afterwards. As these leys will not provide a large amount of keep at this time of the year, all the swedes and half the mangels which have been grown conveniently near should be carted off and stored on these leys; this will minimise the cost of subsequent hauling when the roots are fed afterwards on this land during the winter. Such leys may be ploughed up later for roots, and being firm on the top are not likely to plough up unkindly. Suppose the roots to consist of early turnips, mangels, hardy turnips and swedes the *early turnips* will be folded where grown in August and September, the land should be then ploughed and sown with tares and rape.

Half the *mangels* will be stored in October, where grown, and the ground immediately ploughed and sown with vetches; when the latter commence to bloom the following May, then both crops may be fed together on the land.

Of the other half of the root area where *hardy turnips and swedes* have been grown, these crops as just mentioned are to be carted and subsequently fed on the older clover leys. This land is ploughed in the winter and sown the following spring with vetches and rape, which in its turn will be folded the following summer—June to August. The land will now be in good condition for growing wheat, and considering that it has already borne green crops of some kind during three consecutive years, a crop of barley may be taken after the wheat, when a good sample should be obtained, as the interposition of the wheat crop will check undue rankness in the barley.

After barley, peas and beans may be taken, for which the land will be dunged; the other opportunity for dunging during the rotation occurring in preparing the land for the root crops. By such a system of cropping as indicated in the table below, four-sevenths of the land will be under corn of some kind, whereas in the Norfolk four course only half the land is under corn, so that cropping for the sheep in this way will not reduce the corn acreage.

## A SEVEN COURSE ROTATION FOR STIFF LAND.



There is, of course, no absolute necessity to stick to the green crops mentioned, a variation might be made in several ways. Cabbage transplanted in March, especially of the Early Enfield type, might be fed off in September and October early enough for wheat. Early and Late Trifolium sown on a corn stubble in August should be ready for feeding the following May or June.

Single cut cow grass harvested as hay in July, and the land ploughed up and drilled with kale in August would be ready to feed the following April.

Rye and Winter Oats sown in August and September should provide food by the middle of April, and if left will spring up again and provide a certain amount of food suitable for ewes and older sheep, *but in no case must the lambs be allowed to graze it a second time.*

In the case of the lighter soils the difficulty of providing green food on the arable land is not so great, as folding on this land during the winter months is beneficial. The tables already referred to, coupled with the example given for the stiff soil, will suggest hints as to cropping on such land. Time does not permit of going into a detailed rotation for the purpose ; suffice it to say that often two crops can be obtained in the year on such soils ; for example, rye fed off in April, or vetches fed off in June, leave the land available for a crop of turnips to be put in in early summer for autumn feeding, after which a corn crop may be taken the following year.

As to the acreage necessary under each crop this must be left to individual judgment, because the weight of crop grown is such a variable factor and dependent on soil and climatic conditions. Lambs born in March and April should, when two or three weeks old, be *folded with their dams* on the last of the swedes, and then on rye or clover leys, receiving mangels in addition.

Every opportunity should be offered the lambs at all times of grazing in front of the ewes by means of lamb creeps or hurdles specially made for the purpose.

The trifolium and seeds will last until the vetches are ready, and these succeeded by cabbage may carry them until Christmas, provided they get on to the clover aftermaths as they become available. At a pinch corn stubbles after harvest, especially those under new seeds, may be cautiously fed provided they are not grazed too closely.

The lambs will probably have been weaned at the end of June or in July, and at this date the ewes may be allowed to graze on the grass lands they may have occupied prior to lambing, should green crops be limited ; but not so the lambs. *Never let them know what permanent pasture is until they are at least a year old, if they are to be kept healthy and thriving.* Before Christmas they will be folded on roots cut for them, and so on up to April or May.

Finally it should be stated that when feeding on the clover or sainfoin leys the sheep should be folded, and a *fresh fold* should be provided *each day* with a fall back on to the previous day's fold only. The reason for these precautions is that the ewes may be the carriers of the disease, and if their dung is washed by rain and the lambs allowed to graze on food thus contaminated, this may be the starting point of the disease in the latter. Also should the lambs themselves contain a few worms, the eggs from these deposited on the land have a similar chance of developing and starting the malady.

# GENERAL NOTES.

## 1908.

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# GENERAL NOTES.

1908.

## PRIZE DISTRIBUTION.

The Annual Prize Distribution, instead of being held as usual at the end of the Summer Term, was postponed to October 21st, the day on which the inaugural address for the session 1908-9 was given, in order that both functions should take place on the same day.

The Right Hon. Sir Horace Plunkett, late Vice-President of the Irish Department of Agriculture, distributed the Prizes and Diplomas and afterwards delivered the inaugural address.

The ceremony took place in the Gymnasium, and with the Principal (Mr. M. J. R. Dunstan), who presided, to meet Sir Horace Plunkett were Lord Ashcombe (Chairman of the Governors), Mr. George Marsham (Chairman Kent County Council), Lord Northbourne, Mr. J. Sayer (Governor), Mr. H. E. H. Rice (Governor), and Mr. A. Amos (Governor) ; while others present included Mr. W. Rust (West Malling), Mr. W. E. S. Erle-Drax (Wye), Mrs. Mould (Beckenham), Mr. A. L. Tate (Holcombe) Major-General West (Wye), Mrs. Sharpe (Wye), Mrs. Wellington (Wye), Mr. W. N. Harvey (Chartham), Mr. G. H. Addy (Belmont, Surrey), Mr. S. Eyre-Baxter (Great Chart) and Mr. G. B. Pinyon (Biddenden).

The Principal commenced the proceedings with a brief review of the past session. The success of the College as a teaching, advisory and investigation centre, he thought he might say without boasting, had maintained its high position amongst the Agricultural Colleges of the country. The success attained might be measured first by the high standard of work which was not only aimed at but reached by the students and which standard was on the up grade. But there was room for improvement, and the direction in which he wished to see improvement was in keen application to responsible work. He did not know whether the authorities of our public schools could be induced to inoculate the members of their schools with the spirit of responsible work as well as with the spirit of games. Turning to the qualifications necessary to make the successful farmer the Principal said he had often found that the boy who was not much good at books was selected to follow a farmer's career, but no greater mistake could ever be made, for the man who was to win success from the soil had to be keen, intelligent, businesslike and enterprising, the same qualities which ensured success in other businesses. A man who wanted an easy life had better leave farming severely alone. There was no room for the slacker and the half-trained in farming, and to become properly equipped for it the students' work must not only be keen but continuous. The Principal next referred to the success of the consultative branch of the College's work, and mentioned the fact that their mycological department had awakened a Government department into activity on behalf of the fruit and potato growers of the country, the College in this having performed a national as well as local service. In regard to the scientific investigation side of the College's work, the Principal detailed the various matters which were engaging the close attention of the staff, and then stated that a horticultural department was to be added under Mr. Cuthbert S. Smith, son of Mr. Frederick Smith, the well-known and successful fruit grower of Loddington, near Maidstone. Considerable alterations had been carried out at the College during the past year, but, the Principal continued, much more might be done with advantage. He would suggest that there might be people who would be willing to follow the generous example of that anonymous donor who gave the gymnasium and the useful drawing office to the College, and if so, he could point to an excellent way of building a permanent and valuable record of their generosity. The College wanted a new museum, and he would suggest that a building with entomological and bacteriological departments on the ground floor and a museum above would be a most excellent and permanent memorial. Having briefly referred to the troop of Yeomanry Scouts in connection with the College, the Principal mentioned a new phase of the usefulness of the College. The latest direction in which the College should develop was on the lines of giving assistance to the increasing body of men, the small holders and holders of allotments. Already they had received on application from a man who wished, before actually going into his holding, to receive some instruction in certain processes and certain departments of farming. There were no doubt men who were equipped for taking small holdings, but there were others who were not, and he thought the County Council might hold out some hope of means of instruction, possibly by some short course. In conclusion, the Principal gave his hearty thanks to all who had assisted in making the College attain its success.

Sir Horace Plunkett having been introduced by the Principal, then distributed the prizes and diplomas.

*Diplomas and Certificates.*

Diploma with Honours.—Surveying, R. S. Biscoe. Chemistry, W. R. Dunlop.

Diploma.—R. H. Carter, L. R. de Eizaguirre, G. A. Goodman, W. N. Harvey, G. B. Pinyon, H. Tonks and W. Hopkins.

Certificate.—F. B. Ryder, E. C. Simon and F. S. Hall.

Farm Certificate.—P. Blagrove, W. E. Tremayne, W. R. Tucker and S. M. Bertie.

The following Students satisfied the Examiners :—

Part II. of the Diploma.—H. F. Carter, B. T. Dane and A. V. D. Rintoul.

Part I. of the Diploma.—F. A. Bell, J. H. Mattinson, A. W. T. Nieman, L. A. B. Sharpe, S. Skelton, E. H. Strickland, A. L. Tate, L. Thornley and R. Wellington.

Part I. of the Certificate.—W. W. Brailsford and T. H. Holland.

*Diploma Prizes.*

Third Year.—Agriculture, G. B. Pinyon ; Agricultural Botany, G. B. Pinyon ; Agricultural Chemistry, R. H. Carter.

Second Year.—Book-keeping, Drawing, Building Construction and Surveying, B. T. Dane ; Veterinary Hygiene, E. B. Keiller ; Agricultural Entomology, H. F. Carter.

First Year.—Agriculture, J. H. Mattinson ; General Science, J. H. Mattinson ; prox. acc., R. Wellington.

*Special Prizes.*

Estate Management.—G. A. Goodman.

The Agricola Club Prize for the greatest aggregate of marks in Third Year Diploma Work, G. B. Pinyon.

Horticultural Research.—T. E. Crompton.

*Medals.*

Design for Farm Buildings.—A. G. Cutler.

Collection of Botanical and Entomological Specimens. G. B. Pinyon ; Highly Commended, Messrs. R. S. Biscoe, L. R. de Eizeguirre and H. Tonks.

Poultry Management.—G. B. Pinyon.

The Successes of Students in Outside Examinations were as follows :—

University of London.—B.Sc. Agriculture, H. E. Annett.
Intermediate Science Agriculture, C. J. Alexander, W. B. Burgess and R. Hart-Synnot.

National Diploma in Agriculture Examination.—First Part, H. F. Carter, W. R. Dunlop and R. F. Hankins ; Second Part, R. N. Dowling and G. Fenoulhet.

Surveyors' Institution.—Professional Associateship Examination, R. S. Biscoe, G. A. Goodman, F. S. Hall, W. Hopkins, L. E. Knollys, T. G. O. Cole, W. McGowan and C. J. Sherwin.

Lord Ashcombe moved, and Lord Northbourne seconded, in brief speeches, a vote of thanks to Sir Horace Plunkett, which was heartily accorded and acknowledged.

Mr. Marsham proposed a vote of thanks to the Principal, and referred in the highest terms to the energy and ability he displayed in the affairs of the College, and the success which attended them.

Mr. Sayer seconded, and the vote having been carried with applause, Mr. Dunstan, in reply, said that the credit of the initation of the College on its successful career was due to Mr. Hall; he only continued the course that had been laid down. He also paid a high tribute to the members of his present staff.

## INAUGURAL ADDRESS

SESSION 1908-9,

BY

SIR HORACE C. PLUNKETT.

## AGRICULTURAL COLLEGES AND NATIONAL LIFE.

I am invited to address an audience to whom I am unknown, in an institution with which I have become personally acquainted to-day for the first time. I am expected to say something worth saying upon a scheme of practical education, with which I am in entire sympathy, because I am among those who hold that in education is to be found the chief hope of agricultural prosperity. But the scheme is being administered by a staff of instructors to whose store of specialised knowledge I can add nothing, even of suggestive value. I propose to speak to you, therefore, upon the part which this College may aspire to play in the public life of the country. It is a scheme which—if I am right in the analysis I shall submit of some present-day tendencies—cannot fail to be of interest to all classes of my hearers—the governors, the teachers, the students, their relatives and friends, and even sympathetic outsiders like myself.

Do not understand me to suggest that the usefulness of this College is all in the future. I know by the published reports and from other sources what it has achieved already; but after all it has been in existence for less than a decade and a half. Speaking as one who has had a good deal of administrative responsibility in the organisation of various institutions for the advancement of agriculture and rural economy through education, I can say with certainty that your College cannot yet have determined its ultimate scope, purpose and utility.

Nor would age alone have helped—it might even have hindered—you in meeting the needs of the present time. This house, I am told, dates back to the middle of the fifteenth century, when it provided shelter for twelve priests. These good men, no doubt, prayed fervently that the earth would bring forth its increase without any of those interferences with Providence which I am afraid must fill the pious founder, if he still surveys the scene of his mediæval activities, with a desire to make a holocaust of your Principal and his staff of sorcerers and magicians. Even if, instead of twelve priests, twelve leading husbandmen had been installed here—if the institution had been ever since in the van of agricultural progress—I doubt whether the new function I am going to suggest to you would have been here fulfilled. For it is only recently that the national conscience has been awakened to the urgency of devoting some of the thought hitherto monopolised by industrial life to the condition of those who have remained upon the land.

As citizens we are all concerned for the welfare of the agricultural classes. But your College appears to me to have in this matter a peculiar responsibility, which it is in an exceptionally favourable position to discharge. It is closely linked with the County Councils of Kent and Surrey, upon whose support it largely depends, and whose wishes it must obey. Further, it has working relations with, and is partly controlled by, two great agricultural organisations, the Royal Agricultural Society and the Bath and West of England Societies. And, lastly, it is affiliated to the most influential of modern Universities, that of London, while by giving seats on its governing body to Oxford and Cambridge it derives inspiration and accepts guidance from the two most ancient seats of higher learning in the English-speaking world. From my point of view, it is this union of forces, governmental and voluntary, at the back of the work you do which gives to this College its chief significance.

Here let me say a word upon agricultural education generally, in order that you may understand clearly what appears to me to be the public function of this College—a subject which may be properly discussed while it is in its early, and, of necessity, experimental stage of existence. I mentioned the main facts of its government because I hold that the institution, belonging as it does so largely to the public, will find its ultimate mission in its interpretation of public opinion—a public opinion, nevertheless, which it ought itself to be instrumental in moulding. From the information I have been able to gain, you are satisfying well the requirements of the Education Committees of the two County Councils, to whom you are primarily responsible for this part of your work. You have already impressed your teaching and the results of your experimental and research work upon the agricultural life of these counties. But that is not the aspect of your educational work and influence with which I am now chiefly concerned. Nor do I believe that even in the minds of its local supporters this sphere of usefulness excludes the larger aim of stimulating and guiding the new thought which is being concentrated upon the problems of agriculture and the rural economy of the nation as a whole.

The novelty of this public interest in the wider education of the farmer is perhaps the chief justification for the choice of my subject. Until quite recently farmers had no belief even in the kind of work you are doing—why, then, should mere outsiders be interested in it ? They were not, and as a result, agricultural education is a subject upon which the public mind is very far from made up. Even the pedagogues are, in regard to it, in a normal state of disagreement with each other.

Take, for example, as a single illustration of their diversity of view, the opinions upon what should be taught to a child of the agricultural labourer class—the class whose condition most needs improvement. There are, I have learned, influential pedagogues who advocate a school curriculum, with practical demonstrations on a school farm, which would turn out a boy of thirteen with far more knowledge, both practical and theoretical, than I at any rate, possess. Others, with at least equal authority, favour a sort of platonic acquaintance with nature which need not be varied for town or country, nor have any regard to the prospective career of the pupil, be it on a farm, in a factory town, down a mine, or upon the sea. I am not going to arbitrate on this point, though taking all things into consideration I would say there is more truth in the latter than in the former.

I wish, however, to direct your attention to another line of thought on the wide subject of agricultural education. Institutions aiming at agricultural advancement through education are of two kinds—those which operate directly by giving to the working farmer or farm labourer so much technical instruction as he can apply, and so much adapted general education as will fit his mind and character for life upon a farm ; and those which exercise an indirect influence through the education of agricultural leaders. It is to this second kind of agricultural educational institution that this College belongs, and I take it that, with the exception of a minority who will seek their fortunes in the Colonies, those who go through it will be mostly land agents, teachers and large farmers—the latter a class who have made the agriculture of Kent justly famous. This was evidently contemplated from the foundation of this College. When it was less than two years old the late Duke of Devonshire, who really filled the position I momentarily occupy, made a speech as weighty as his public utterances always were. One passage in this speech so impressed itself on the mind of the College that it still stands upon the title page of its admirably compiled prospectus. I am sure most of you know the passage in which the Duke called on his brother landlords to appoint as land agents and other persons in a position of trust on their estates, men who had received such an education as could be obtained at this College. " In an agent on a well-managed estate," said the Duke, " the tenantry ought to be able to find an adviser, a man who would give them assistance on any points of scientific agriculture with which they might not be perfectly familiar."

Now that requirement is unquestionably fulfilled in the case of those who pass through this institution with credit. But since these words were uttered much water has flowed under the bridge, and the function of agricultural leadership has assumed a greatly enhanced importance. Social and political thinkers are becoming far more interested in the welfare of the rural population than was the case twelve years ago. The Press, almost daily I might say, discusses the means by which a larger number of the population may be induced to remain upon the soil, and the problem of unemployment is being discussed on its rural, as well as on its urban, side. From every point of view the need for a clear understanding of the problem is becoming more manifest, and we are constantly reminded of its difficulties and complexity. The present Government has a policy aiming at its solution for Ireland; another policy for England, and a wholly different one for Scotland. It is more than probable that those of us who are not very old will look back upon many of the present day legislative proposals as being almost as crude as the policy of "three acres and a cow."

If you accept my main contention that to this College belongs the privilege and duty of leadership in a movement to avert the threatened breakdown of our rural social economy, I do not think we shall differ either as to the causes of the evil or the broad lines of the remedy to be applied. What is called "the rural exodus" is clearly due to the bewilderingly rapid succession of invention for applying the natural sciences to every part of the people's life. Then economic science gave its blessing to urban concentration and rural depopulation, because people crowded together could use that weapon of industrial competition, division of labour. After a brief period of national demoralisation, consequent upon the abounding wealth while England was establishing her commercial and industrial supremacy, a social and political development followed in the wake of the economic revolution. But this chapter in national progress belongs to the new centres of population—to the town and not to the country.

I fully recognise how inadequate is the sketch I have given of that great range of tendencies which have revolutionised our civilisation and have produced such profound changes in the life of those who remain upon the land. But perhaps I have said enough to give substance and reality to the suggestion that a new agricultural leadership and a new class of leader are required. If my estimate of the trend of public opinion be approximately true, the State will be compelled to undertake many functions, formerly left to private initiative, perhaps as a natural sequel to radical changes in land tenure. A large number of men will be needed for agricultural administration. Once the national importance of the rural problem is recognised there will be increasing scope and opportunity for those who can contribute something solid to its solution. I would almost venture upon the forecast that a sort of Agricultural Civil Service will be created; and if things move in this direction it is safe to prophecy, although it would be hard to measure, the resulting development of this institution's work.

When we turn to the country side of things and see what modern science has done for the rural population, we find that, while the industry upon which they live has been greatly advanced, there has been no similar advance in the interests and amenities of life upon the farm. Not only have all the economic activities which formerly prevailed in the country, except the cultivation of the soil, been taken to the towns, but domestic life has been robbed of the home manufacture of its food, drink and clothing. Country life thus lost not only its independence, but also a great deal of its human interest. I sometimes think that many who are working upon the rural life problem are wrongly endeavouring to restore rural industries. They surely perished because they had lost their economic justification. The problem to be solved is not how to put the clock back in the country, but how to put it on. We have to recognise that life upon the farm must in its nature be laborious, and that although by no means necessarily wanting in physical comfort or enjoyment it cannot have the diversions and varied attractions of the town. Taking things as they are, and accepting the permanent conditions of the staple industry, we have to find out how we can, within the means and resources of a rural district, build up a life equipped with some counter attractions to the social and intellectual advantages which every progressive modern town increasingly affords.

For the attainment of this end I have no simple means to suggest. It may, however, be confidently asserted that as in all social problems the solution must be sought in education. Of course for the largest and most lasting result we must look to the education of the rising generation. But we cannot wait for this. The existing farmers must in certain matters be educated. So, in addition to the obvious aim of equipping the pupils of the College with useful knowledge, I suggest that you should have before the minds of those who are engaged in the training of agricultural leaders, the necessity of supplementing governmental action and rural education with the organisation of voluntary effort. I know of no more effective way of bringing this about than first to study and then support the agricultural co-operative movement.

There has been recently a good deal of talk about agricultural co-operation, but it is as yet very far from being understood. In its purely business aspect this important agency of rural progress is nothing more than the application to farming business of the principle of combination, which those engaged in every other industrial or commercial undertaking, and also the farmers of every progressive European country, have been forced to adopt. The advantage to the farmer of large transactions over small is obvious, but perhaps it is not fully appreciated in its relation to the food supply of the great centres of consumption, which is the major portion of the demand of the modern market. It is recognised as essential to the health and prosperity of a great city that its food should be supplied regularly, and in bulk of uniform quality. These conditions of rapid and economic distribution, rendered possible only by the development of steam transportation and the invention of means for preserving produce fresh through the longest journeys, are fulfilled by all consignors to the British market, except those who by their proximity to it are in the best position to fulfil them. Failure on the part of our farmers to combine in marketing raises a great barrier of middle profits between the producer and the consumer which they fondly hope will be demolished by the battering-ram of tariff reform. They would find co-operation more effective.

As I am speaking in Kent, I may mention that some well-informed friends who are advocates of agricultural co-operation tell me that the present state of the hop industry affords a good illustration of the urgency of the reform of which I speak. Under prevailing conditions, the least over-production seems to result in the grower being completely at the mercy of the buyer, the unorganised producer having no control over the organised market. The hop-growers of England are not a large body numerically ; they are among the most progressive of farmers, and have capital behind them. Their strongest tradition is that of self-help, but it is of the highly individualistic kind. It has now become necessary to order to meet the conditions of modern competition that self-help should be organised, and it looks to an outsider as if this worthy body of citizens were the victims of their virtues. I, of course, speak with diffidence, but those who are familiar with all the conditions tell me that a combination for the sale of hops is clearly indicated, that the growers ought to establish an agency of their own upon co-operative lines, that an impartial and competent officer of the association should grade the produce of the members, and that the aggregate should be disposed of in accordance with the demand of the market, a distribution of the proceeds being made among the members from time to time, to each in proportion to the quantity and quality of the produce brought into the combination. Such an agency could easily establish a credit, perhaps without going outside its wealthier members, who might make temporary advances of working capital, so that those members who could not conveniently wait for the return from their year's operations might be financed for a while. They would thus be prevented from injuring the common cause of this great British industry, upon which depends the welfare of perhaps some hundred individuals for every one master hop-grower, by setting up a cut-throat competition where a steadying co-operation is required. But when all this is pointed out, my informants seem to think that the man who embarked upon the task of organising hop-growers upon the lines suggested would have a pretty hard row to hoe. Not only would all the influence of the traders be thrown against such an organisation, but the growers themselves do not possess the habit of working together, and lack the mutual confidence necessary to bring it to a successful conclusion.

Here, then, is a situation clearly demanding the best thought of those to whom the duty of what I have called agricultural leadership properly belongs. It is obvious that no progress which you are able to effect in the practice of farming will go very far towards the rehabilitation of rural life if the business methods of farmers remain so far behind those of the commercial and industrial populations and our agricultural competitors abroad. Just because institutions like this have not done in the past all that they might have done to promote the necessary educational reform, agricultural co-operation had no spontaneous growth. The Irish Agricultural Organisation Society, founded in the same year as this College, was the earliest recognition that direct influence must be brought to bear upon the adult members of the farming community to induce them to alter their methods in Ireland, following the example of their Danish rivals, who had altered theirs as the natural result of the education they had received in their youth. Owing to the defective educational foundation upon which the I.A.O.S. had to build, and to political opposition inspired by anti-co-operative interests, the work has been costly and arduous and the progress slow. Still this much at least has been gained: the principle of agricultural co-operation is now generally accepted, and has been practically applied to the business of a hundred thousand farmers. In England and Scotland, Agricultural Organisation Societies have followed on the lines of the pioneer body, and perhaps you have seen that in the present year the leaders of the three movements have formed two joint Boards, one for mutual consultation in all matters relating to organisation, and the other for combined action wherever the agricultural interest can, in its relation to manufacturing or distributing interests, be benefited by combined action. Knowledge of what is being done by these associations, and support of the English Agricultural Organisation Society, should be embraced in your scheme for getting into helpful relationship with other workers in rural regeneration.

The two respects, however, in which agricultural co-operation should chiefly commend itself to the teachers and learners in this College are its educational and its social value. With regard to the former, I can tell you as matter of personal experience that organised farmers are not only more appreciative of such technical advice as you can give, either to adults upon their farms or in the training of their sons, but they are in a much better position to turn the newer knowledge to account. And in the matter of social advancement it is equally well known that men and women who have learned to work together in the business of their lives spontaneously use their business organisation for the purposes of social and intellectual enjoyment.

For these two reasons I hold that the co-operative movement is an integral part of any comprehensive scheme of rural betterment. Speaking as one who for twenty years has been constantly engaged in the task of organising farmers into associations for applying co-operation to the different branches of their industry, I am in a position to tell you how you can render invaluable assistance to those of us who are struggling to introduce this necessary reform. The agricultural organiser finds his work revolving in a vicious circle, which the agricultural leader must help to break. Apart from the innate conservatism of all agricultural communities, agricultural co-operation in Great Britain is confronted with a peculiar difficulty. Large farmers have not, immediately, at any rate, so much to gain from the proposed reform as their smaller neighbours. Small farmers refuse to follow where their natural leaders will not lead. And yet to the longer view the large farmers are wrong, as they may discover to their sorrow in a no distant future. The political influence of the agricultural interest, in common with that of all business interests, varies directly with the efficiency of its internal organisation. There is no other way in which farmers can exercise control of legislation and administration affecting their business except by organisation for business purposes, and there is no system of combination which will suit their conditions except the co-operative system. You should, however, in my judgment, appeal to the large farmers on the higher ground of civic duty, and try to show them that their position and influence will be greatly enhanced by rendering to their poorer neighbours a much needed and immensely valuable social service.

From what I have said you will have noted that I anticipate what would be almost a revolution in rural economy—a change from unorganised to organised production and distribution. That the organisation of farmers will itself create a demand for a new type of agricultural leader can, I think, hardly be doubted; and you may ask me what definite suggestion I have to make as regards his training. I can say generally that the man who is now qualifying himself by a technical knowledge to be an adviser of farmers will in one respect, at any rate, require a broader education than can be obtained by any specialised courses which can be set out in a prospectus. He will have to be not only a technical expert, but in some degree a sociologist—by which I mean that he will have to see rural life clearly, and see it whole. He will have to understand not only how particular crops may be grown or particular animals bred and fed in particular districts, but will want to know what scheme of life will content the several rural classes with an agricultural existence, what will induce them to throw in their lot with the country instead of availing themselves of the wider opportunities afforded by the great centres of commerce and manufacturing industry.

I was speaking just now of the great diversity of view which existed upon the education of the rural labourer's child. It was, after all, a question mainly of the outlook to the country which was to be implanted in the bucolic mind. I cannot help thinking that at the opposite end, as I might call it, of rural education, a new outlook is also needed. I daresay I could suggest some additions to the curriculum which would embrace the more human side of rural economy. But I could also conceive of an agricultural education which would go far to produce the kind of leadership which is most urgently needed, if only to protect farmers from politicians, without the inclusion of any practical agriculture whatsoever.

What I have in mind for institutions such as this is no specific course of studies, but rather a general agreement that this problem of rural regeneration should be accepted as a great public duty and aim. Its discussion might be conducted in regular and organised debates, to which outsiders in touch with public affairs should be invited. Such a use of what might be largely the time of recreation, so far from diverting the mind from the more specialised studies, would, I am convinced, immensely broaden and add to their interest. All educational institutions, except perhaps that of the mere crammer, ought to possess a mental and moral atmosphere which makes a lasting effect upon the character and outlook of its alumni. It is just because the South Eastern Agricultural College is at a stage of its existence when its traditions and influence are in the making, and because I am convinced that those who are devoting themselves to the upbuilding of the institution are inspired by patriotic motives, that I have ventured to put before you the aspect of your work which in my judgment is at the moment the most widely important. I cannot think of any nobler ambition to set before all who are supporting the College, either from the outside or as teachers and pupils, than that of raising the dignity of the patriarchal calling and putting heart into those who are following what, in an evil day people have come to forget, is the only necessary, the most ancient and the most honourable of human occupations. I wish this College a long future of usefulness and commensurate with the promise of its early years.

## SUMMER TEACHERS' COURSE.

The usual course for Kent and Surrey Schoolmasters was held from August 17th to 29th. As in previous years the course was divided into Elementary and Advanced, and included the following subjects :—Chemistry, Botany, Zoology, Land Measurement, Horticulture, Bee-keeping and Poultry.

About fifty Schoolmasters joined the Natural History excursion to Folkestone. On the previous evening a short lecture, illustrated by lantern diagrams, was given by Mr. S. T. Parkinson, pointing out the geological features of the country in that district. The Folkestone Natural History Museum was first visited, where Mr. G. C. Walton, F.L.S., President of the Folkestone Natural History and Microscopical Society very kindly pointed out the objects of special interest. Mr. E. Horsnaill, a Vice-President of the Society, drew attention to the Geological and Mineralogical plans, maps and specimens. The party then proceeded to the Warren. After a short general demonstration of the Geographical and Geological features of the place, the members of the party separated into sections under various leaders. Entomology (Mr. F. V. Theobald), Geology (Mr. Horsnaill and Mr. B. N. Wale), Botany (Messrs. S. T. Parkinson, Chamberlaine, C. J. Alexander and R. H. Carter).

Mr. H. F. Abell, of Kennington, gave a popular lecture on the "Interests of Hereabouts," in which he described places of interest in the districts round Wye, and the Principal gave two popular lectures on Cellulose and its use in the arts and manufactures.

Sixty-seven teachers attended the course, thirty-eight coming from Kent and twenty-nine from Surrey.

## FRUIT-GROWERS' CONFERENCE.

Fruit-growers from all parts of Kent and many neighbouring counties were present in large numbers at the South-Eastern Agricultural College, Wye, on Friday, November 27th, 1908, for the annual conference of those interested in the industry. Mr. C. W. Radcliffe Cooke, President of the English Cider Merchants' Association, occupied the chair, and was supported by the Principal, Mr. M. J. R. Dunstan and Mr. G. L. Courthorpe, M.P., while amongst those present were :—Mr. and Mrs. Barnett (Swanley), Colonel Honeyball, Miss Kekewich (Swanley College), Rev. F. Chambers (Chart Sutton), Captain Reid (Yalding), Major Pilleau (Marden), Messrs. P. Cutbush (Harrietsham), H. G. Taylor (Penshurst), J. M. Higgs (Farnborough), R. A. Whiting (Faversham), D. L. Pattullo (Longfield), H. Chapman (Greenhithe), G. E. Norton (Marden), G. T. Burton (Hawkhurst), Power and Wiffen (Ross), R. G. Notcutt (Woodbridge), G. Norris (Chartham), J. Stevens (Egerton), W. P. Hinds (Smarden), G. Bensted (Ulcombe), S. W. Mount (Canterbury), J. Edmonds (Rochester), J. Raynham (Marden), H. T. Busted (Sittingbourne), H. E. Pollock-Hodsoll (Wembley, N.W.), H. Hughes (Cranbrook), J. Butler (Smarden), C. Lee (Swanley), N. D. Berry (Boughton), P. Manwaring (Brenchley), S. and E. Reader (Brenchley), W. Maylam (Pluckley), K. G. Furley (Tonbridge), A. Mannington (Yalding), C. Bates (Mersham), H. T. Manwaring (Marden), E. Fowler (Canterbury), G. H. Buley (Woodnesborough), C. Moon (Surbiton), W. Harvey (Kennington), L. Ashbee (Throwley), W. H. Watson (Horton Kirby), J. Duncanson (Langley Park), W. H. Nicholls (Broadstairs), L. Wheeler (East Peckham), A. Birt (Smarden), B. G. Berry (Boughton), F. Waite (Boston), W. V. Tabrett (Boughton Aluph), H. Millgate (Egerton), H. Reader (Yalding), H. J. Wickham (Yalding), G. H. Vane (Mersham), W. Stedman (Rainham), G. Hooper (Pershore), E. J. Overy (Paddock Wood), G. C. Champion (Maidstone), R. Reader (Marden), E. S. Butcher (Maidstone), H. Wigley (Gravesend), J. C. Brown (Leeds), F. Smith (Loddington), W. Willmer (Boughton Malherbe), W. Rogers (Horton Kirby), C. Fletcher (Yalding), H. C. Jones (Biddenden), J. D. Maxted (Littlebourne), L. H. Page (Sittingbourne), F. I. Neame (Faversham), L. Doubleday (Sittingbourne), E. Colthup (Canterbury), R. Amos (Wye), J. Selmes (Newenden), R. G. Maxted (Wingham), W. Chambers (Southfleet), T. A. Winshurst (Brenchley), W. G. Chandler (Ash), G. Hodges (Newington), W. E. Wallace (Dunstable), Henry Noakes (Brenchley) Jas. Harvey (Hurst Green), T. E. Crompton (Petersfield), J. H. Birth

(Chartham), A. T. Merryweather (London), C. E. Cheetham (Chartham), C. Manktelow (Staplehurst), G. Ballard (Stockton), W. Weeks (Maidstone), W. R. Pierce (Canterbury), Thos. Judd (Marden), Geo. Mount (Canterbury), W. H. Skinner (Boughton Monchelsea), Jas. White (Upper Hardres), R. J. Sankey (Croydon), A. Vinson (Belvedere), S. Swinford (Herne), C. S. Martin (Winchcombe), O. Vinson (North Cray), G. Austen (Teynham), G. J. Pearson (Brabourne), B. Champson (Mereworth), H. Chapman (Lenham), H. Woodhams (Robertsbridge), S. Dann (Paddock Wood), H. C. Hambrook (Wingham), Duke and Ockenden (London), G. Arnold (Paddock Wood), L. Fletcher (West Farleigh), Drake and Fletcher (Maidstone), H. S. Tett (Faversham). Altogether between 400 and 500 persons were present.

The proceedings were commenced by the Principal (Mr. M. J. R. Dunstan), extending a hearty and cordial welcome to the College. He hoped that the conference would result in suggestions of practical utility to fruit-growers, and asked for frank and free discussion upon the methods and theories put forward by the lecturers, the College always welcoming expressions of opinion of all kinds.

The Chairman then briefly addressed the conference. He referred to the need of a special department of the Board of Agriculture for looking after the interests of the fruit-growing industry and then called upon Mr. E. S. Salmon, the Mycologist at the College, to read a paper upon "Spraying and Spraying Machinery."

Mr. Salmon then said :—

Although spraying and spraying machinery is our chief subject for discussion this morning, I should first like to make a few remarks respecting three fungus diseases, *viz.*, the American Gooseberry Mildew, the *Botrytis* disease of the Gooseberry, and the "scab" or "black spot" of the apple and pear.

With regard to the American Gooseberry-mildew, its general appearance is unfortunately becoming more and more familiar to growers in Kent, since this new pest is gradually extending its area. There is no time now to go into the whole question of the introduction of this mildew from America into Ireland and the Continent (which took place about the year 1900), and of the continued inaction of the Agricultural Authorities,—even when fully warned—to take any steps to keep the pest from coming into England, or to stamp it out when the first few outbreaks were discovered. I will only remind those present of the fact that it was here in this room, at a fruit-growers' conference held two years ago, that the announcement was first made of the discovery of the American Gooseberry-mildew in England.* On that occasion *viz.*, on November 7th, 1906, a Resolution was passed unanimously, calling upon the Board of Agriculture to take legislative action.

Now although this College, in conjunction with the National Fruit-growers' Federation, was instrumental in getting the "Destructive Insects and Pests Act" introduced as a Government measure and passed into law on July 4th, 1907, we are far from approving of the measures which have been taken under the new Act for the control of plant pests. I am afraid that—since now no grower can be legally compelled to destroy a diseased bush,—we shall find that the attempt to stamp out the American Gooseberry mildew in England, has practically been abandoned.

At a meeting held last week by the Royal Horticultural Society in London, I heard Mr. F. W. Moore,—who acts for the Irish Department of Agriculture—say in reply to a question: "This mildew is too serious a thing to be trifled with. We in Ireland have found out a way to deal with it; it is, burn the bush." I thought as I heard this advice given, what a difference it would have made as regards the way the American Gooseberry-mildew has been dealt with in England if we had had in this country a State Department of Horticulture whose officials would have given such advice when the first outbreaks were discovered in this country. As it was, you will remember that this College had to fight for many months that foolish story, that the American Gooseberry-mildew had existed for thirty years or more in England, and had proved incapable of doing any serious harm. It is only two years ago since that story was widely circulated, but I do not think there is a single person in this room to-day who is not now convinced of the fact that this mildew is a new and dangerous pest which we have to cope with for the first time in this country.

Now with regard to the occurrence of the American Gooseberry-mildew in Kent, we have lately ascertained the fact that this mildew has existed (in North Kent) for probably the past three years. In some cases the existence of the disease appears to have been deliberately concealed, from fear that if discovered an Order might be made to grub up the affected bushes without the payment of any compensation. As most of you know, since legislation has been introduced to deal with the mildew,—giving local inspectors the power to make a systematic search,—we now find ourselves confronted with an outbreak affecting already 1,787 acres of gooseberry plantations. I have seen, in the Swanley district, plantations so severely attacked that practically every young shoot of the bushes was diseased. In other cases in Kent I have seen the disease so virulent that it has stopped the growth of young bushes.

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* See *Journal* S.E.A. College, Vol. xvi., p. 410, 1907.

We have been able during the past months to collect a certain amount of evidence as to how the mildew spreads. First and foremost, the mildew spreads by the wind carrying the "summer spores." Numerous cases have come under my observation, and under the observation of the Inspector of the Kent County Council, where the outbreak when first discovered has consisted of only a few bushes, and then where the grower has neglected to spray these few bushes at once a second inspection of the plantation a few weeks later has shown that the *spores* of the mildew blowing on the wind had spread the disease so quickly that a quarter of an acre, or half-an-acre of the plantation had become affected.

Under certain conditions, no doubt, the wind can carry the disease to a considerable distance,—a mile or so; and bees and other insects, and perhaps hares, play a part in spreading it.

We have also collected definite evidence that fresh districts in Kent have become infected by the planting up of young diseased bushes brought from "infected" districts. Frequently a grower has farms in different parts of the county; cases have occurred where diseased young bushes have been taken from one farm and planted on another farm in a district hitherto free,—and thus spread the disease. We have been able in some cases actually to trace the spread of the mildew in such a way: *e.g.*, the district of Wrotham (hitherto free) was infected by diseased bushes brought from the infected district of Swanley; the "free" district of Boughton Monchelsea was infected by diseased bushes brought from the infected district of Rochester ; the district of Maidstone was infected by diseased bushes brought from the infected district of Southfleet ; and so on. Now this manner of spreading the disease must be stopped at once, or the whole county of Kent will very soon be infected. One of the most important provisions of the American Gooseberry-mildew Order now in force in Kent is that forbidding the removal of diseased bushes from infected areas.

Passing now to the subject of the best way of dealing with this disease, my earnest advice to you is that you should not only carry out strictly the measures required by the American Gooseberry-mildew Order now in force,—but that you should do more. Where the outbreak consists of only a small number of diseased bushes, I strongly advise you to grub up and burn those bushes.

If we consider the details of the life-history of this mildew,* we see that the most important time to spray is in the early summer (see Plate 27), and I most strongly advise you, on the first appearance of the mildew next year in any plantation, to drench the affected bushes thoroughly with a solution of " liver of sulphur." It is not of the slightest use to spray in the winter ; the only way of dealing with the disease at that time is by pruning and burning all the affected young shoots.

One important fact which I have to bring to your notice concerns the manner in which the American Gooseberry-mildew attacks the Red Currant, since this constitutes a new and unexpected source of danger. On the Gooseberry the winter-stage of the mildew is formed on the young shoots (see Plate 29) and not, in my experience, on the leaves,* but on Red Currants (which have already been attacked in a few plantations in Kent) I have found the winter-stage formed on the leaves (as well as on the young wood) (see Plate 30). In such cases if the leaves of the Red Currant are allowed to fall to the ground in the autumn, nothing can be done to prevent the winter-spores arising from the ground during the following spring or early summer, and bringing about re-infection of the Red Currant—and adjacent gooseberry bushes—even though by winter pruning all the infected shoots had been removed and burned. On this account, then, we see that there are additional reasons for taking drastic measures to present the mildew spreading over Kent, and attacking Red Currants generally, since on this bush the mildew would be extremely difficult to deal with. Any grower who finds his Red Currants being attacked, should at once grub up the bushes.

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* Lantern slides, prepared from photographs of affected leaves, shoots and berries, were shown illustrating the details concerning the formation of the winter- and the summer-spores, and the manner in which they spread the disease.

There is one very important point to which I wish to draw your attention. If fruit-growers in Kent mean to make a determined and systematic attempt to deal with this new pest—and I know that many growers are already spending a considerable sum of money in doing so—then it is absolutely necessary if they are to reap the benefit of this line of action that neighbouring counties where the disease exists should take the same measures as Kent is now required by law to take. When the first outbreak of the mildew in Kent was reported on July 14th last, after I had visited the affected districts and seen that the Kent County Council was provided with properly qualified men to serve as Local Inspectors to carry out the Order, the next step taken was to investigate whether the adjoining counties of Essex and Surrey were free of the disease or not. The Board of Agriculture on being applied to, stated that they were unacquainted with any outbreak in either of these counties. However I discovered the mildew in this county on August 11th, *i.e.*, within a month of the first recorded outbreak in Kent. On October 1st last, I discovered the first outbreak in Surrey.

Now, how are these outbreaks in these counties being dealt with? On my acquainting the Board with the occurrence of the disease in Essex, they promptly issued an " American Gooseberry-mildew Order " for that county, similar to the Order issued for Kent. An Inspector from the Board was sent to the district where I had found the disease, and it was soon discovered that a very considerable number of infested plantations exist in Essex. Unless the area of infection in Essex is located through the work of competent inspectors, and then properly dealt with, the mildew will certainly spread over that county, and growers in Kent will be continuously exposed to the danger of diseased bushes being brought from Essex into Kent, or possibly to the danger of the summer-spores of the mildew being blown across the Thames.

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* It has been reported on gooseberry leaves, but only very exceptionally.

How is the disease being dealt with in Surrey? On October 1st last I informed the Board of the existence of the mildew in that county, and I asked to be informed when an "American Gooseberry-mildew Order" would be issued for Surrey. The only reply I received was the official note of acknowledgment. I then invoked the help of Mr. Laurence Hardy, M.P.,—who has given the College so much assistance in inducing the Government to pay attention to questions affecting fruit-growers—and the following question was put in the House of Commons on November 12th last: "Whether the Board were advised, as long ago as October 1st, that an outbreak of Gooseberry-mildew had occurred in the county of Surrey; and whether any Order has been issued by the Board to deal with the disease in the county of Surrey." The official answer, given by Sir Edward Strachey, was as follows: "The reply to the first part of the question is in the affirmative. The Board have no evidence to show that the disease is spreading in Surrey, and have not therefore considered it expedient to issue a special Order for that county at present." This means that no systematic search in that county can be carried out by Local Inspectors under the County Council, although such a search would probably,—judging by what we have found to be the case in Kent—reveal the presence of the mildew in many plantations and nurseries. Yet if the infected areas in Surrey are not tracked down and dealt with this winter it is most probable that the mildew will increase next summer, and then not only may diseased bushes from Surrey be sent into Kent (and other counties), but the summer spores of the mildew may spread the disease over the county borders into Kent.

When Mr. Laurence Hardy asked the Board on November 12th last, whether they would proceed against the outbreak in England and Scotland of "wart disease" in potatoes by adopting the same scientific measures as the Irish Department of Agriculture have carried out in Ireland, viz., the immediate destruction of all diseased tubers, he received in the House of Commons an answer to the effect that they could not entertain this method of dealing with the disease, because (to quote the official words) "the number of outbreaks of this disease in Great Britain is far greater than is believed to be the case in Ireland." At present it is unfortunately the fact that the fruit-growers of this country, through the absence of a Horticultural Department, are deprived of that State assistance in the control of plant pests which the growers of all other fruit-growing countries have enjoyed for many years.

There are gentlemen present to-day who took part in the Departmental Committee appointed by Lord Onslow in 1905 to inquire into the fruit industry. Many of you will remember that the first of the Recommendations which that Committee sent up to the Government was to the effect that it is necessary that a special sub-Department of the Board of Agriculture should be established to deal with matters connected with the fruit-industry. This Recommendation has never been carried out. It is unfortunately the case that we have obtained the passing of the "Destructive Insects and Pests Act" before the creation of a properly organised sub-Department, or Board of Horticulture, possessed of sufficient energy and scientific knowledge and foresight to issue the necessary Orders against plant pests.

Before closing the subject, let me put in a plea for better organisation among English fruit-growers. We need a strong and really representative National Fruit-growers' Federation. The existing body,*—whose members have been working disinterestedly for many years for the good of the industry, and through whose efforts much useful work has already been done—has too small a membership to be able to do the amount of work which a National Federation should do. I strongly recommend all those present, who are not already members, to join this Federation; if the rank and file of English growers would unite, there is no reason why this Federation should not become that strong representative body of growers which the fruit-growing industry of Great Britain so urgently needs. With such increased strength the Federation would be able to see one of its chief objects realised, *viz.*, the carrying into effect of the first Recommendation of the Departmental Committee of 1905, and this country would then, like our Colonies and other foreign countries, possess a Board of Horticulture to protect and foster the interests of the fruit-growing industry."

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* The National Fruit-growers' Federation. Secretary, Mr. W. Miskin, Royal Horticultural Hall, Vincent Square, Westminster, London.

Mr. Salmon then dealt with the *Botrytis* disease of the Gooseberry (see p. 321). The "Black Spot" of the apple was next dealt with, and in connection with this the lecturer touched on the subject of the injury that is sometimes caused in some seasons to apple trees by spraying with Bordeaux mixture (see p. 255). Advice was given to growers to pay attention to the following points in order to escape this injury as far as possible: (1) spray in moderation; spray to cover the foliage and fruit with a thin film, and yet not have the trees drip heavily. (2) Some varieties of apples may be sprayed without much fear of injury; others must be sprayed with great care. Distinguish between the varieties in spraying.

The lecturer then passed on to an illustrated account of the making of Bordeaux mixture and of the best types of spraying machines and nozzles (see p. 240). At the conclusion of the lecture, Mr. Salmon gave a practical demonstration of spraying with different nozzles fitted on various spraying machines, of which a considerable number were on show in the College grounds, adjoining the lecture room. In the course of this demonstration the right kind of spray with which Bordeaux mixture should be applied was shown, and the fact emphasised that no hop-washing nozzle gave a suitable spray for this purpose.

Luncheon was then served, and after the toast of "The King," proposed by the Principal, Colonel Honeyball submitted "The Houses of Parliament," and in so doing referred to the services of Mr. Courthope, the Member for the Rye Division, and of Colonel Brookfield, a former Member of the Division.

Mr. Courthope, M.P., in reply, spoke at some length upon the relation of the State to Fruit-growers. The Boscawen Committee, which went into the matter, reported in 1905, and made a great number of useful recommendations, but although plenty of time had elapsed since then only one of those recommendations, so far as he was aware, had been carried out, namely, the making retrospective of Section 4 of the Market Gardens Compensation Act. He then drew attention to the remissness of the powers that be in fostering the fruit-growing industry of this country, and contended that there should be a separate department of the Board of Agriculture in order that growers might be provided with the best and fullest information free of cost to themselves. He referred to the splendid example of British Columbia in this connection. Both Liberal and Tory Governments, he contended, had wholly neglected their duty to the fruit-grower, and he urged that it was imperative that Government should be forced to follow the example of the Colonies, and go in not only for experimental stations, but for fruit farms where all the knowledge of the subject it was possible to acquire should be gained at the national expense and placed at the disposal of the individual growers, who could not possibly risk their capital and their livelihood by so doing. The clauses of the Finance Acts affecting local and imperial taxation also required revision. The first was the Rating of Market Gardens. Market gardens, and formerly hop gardens, were rated under a special rule in the same manner as the schedule D assessment, and agriculturists ought to press for the repeal of that rule, as far as market gardens were concerned, in the same way as in 1853 hop-growers got it repealed as far as the hops were concerned. That would be a real benefit, particularly to the grower who had recently planted, and who was not getting the full benefit of his orchards. In some parts of the country the assessment of orchards and plantations was raised almost immediately after planting, a manifestly unfair proceeding. The Boscawen Committee recommended that a statutory provision should prevent this, and that the increase in assessment should only take place after five years in the case of small fruit, seven years in the case of mixed plantations, and twelve years in the case of orchards. Those periods he thought were reasonable. Another thing was that fruit that was not grown in an orchard was not the subject of a larceny charge, and in the case of a tramp taking such fruit the only thing to be done was to bring an action against him in the county court. But what was the use of bringing an action against a man of straw ? Mr. Courthope next advocated the inspection of fruit and fruit pulp from abroad. But it was the fault of the agriculturist himself that agriculture was not properly looked after by the State, and its proper fostering could only be secured by having agricultural members representing county seats and thus securing a body strong enough to force the hands of any government which might be in power. Mr. Courthope then concluded by proposing " The College," coupled with the name of Mr. Dunstan.

The Principal, in reply, drew attention to the great progress the College had made, and to the successes gained by its students at the London University examinations, three having recently gained the Bachelor of Science degree, and most encouraging reports having been received from employers of old students. The College was also growing in popularity, as well evidenced by the splendid gathering of horticulturists that day. He also spoke highly of the work of his staff, and concluded by proposing the health of "The Chairman," who briefly expressed his acknowledgments.

## INSECTICIDES.

The first subject taken after luncheon was "Insecticides," by Mr. S. U. Pickering, manager of the celebrated trial grounds of the Duke of Bedford. Mr. Pickering referred to various insecticides upon the market as valueless or almost so, and said that his advice in choosing them would be to be very chary in investing in them. Various tabulated statements were then thrown upon the screen to illustrate practical experiments made and results obtained. The Woburn Wash, a simple preparation of paraffin and caustic soda, it had been found, was the best thing for destroying mussel scale and for removing moss and lichen, but it failed with psylla. For the latter pest a lime and salt wash no doubt did some good, but it was uncertain in its results. A wash of one per cent. of carbolic acid produced no mortality, but nicotine was found very effective. Treating with a wash of 0.75 per cent. of nicotine about ten days before the blossom opened proved fatal to the psylla. Very similar results were obtained with washing when the blossoms had fallen. It was found that nicotine had no effect upon the winter moth caterpillar, but that an addition of lead arsenate did not interfere with the action of the nicotine and killed the caterpillar. As to whether bees were affected by the wash it was difficult to say, but no effect could be seen by a trained bee-keeper upon bees near trees which had been sprayed. The chief objection to the wash was its expense, rather more than 1s. for every ten gallons. Mr. Pickering next referred to the treatment of trees for woolly aphis. The most satisfactory results were obtained by dipping young trees bodily in water heated to 115 degrees for ten minutes. A higher temperature was equally efficacious so far as the aphis was concerned, but retarded growth, whereas the lower temperature appeared to encourage it. Dipping the young trees in petrol had also been found efficacious.

### A COLONIST'S DEMONSTRATION.

Mr. Scott, a fruit grower of British Columbia, next described the nature of the work of the agricultural department of that colony. Referring to washes Mr. Scott stated that while Bordeaux mixture remained a standard wash, it had now under certain circumstances been superseded by one of lime, salt and sulphur applied hot (the ingredients being 30 lbs. to 40 lbs. of quick lime, 20 lbs. finest flowers of sulphur and 15 lbs. of salt to 50 gallons of water). This wash was found in British Columbia to be efficacious for pretty nearly everything. Answering various questions upon various phases of fruit-growing, Mr. Scott informed the Conference that the American Gooseberry-mildew had made gooseberry culture in the Colony impossible. He then gave a practical demonstration of the grading and packing of apples for market.

The Chairman, having made a few remarks, in which he again urged the absolute necessity of combination amongst fruit-growers, declared the conference closed.

# WEATHER REPORT FOR 1908.

| | Number of days rain fell. | Inches of Rain. | Average daily Sunshine. | Notes. |
|---|---|---|---|---|
| | | | h. m. | |
| January | 13 | 1.66 | 2.8 | Temperature below the average. On the coldest night thermometer registered 26° of frost. |
| February | 12 | 1.45 | 2.52 | Temperature above the average. Only one cold night. |
| March | 17 | 2.23 | 2.50 | Cold and wet. |
| April | 12 | 1.615 | 3.53 | Very cold; 11° of frost on the 21st. |
| May | 12 | 1.99 | 5 | Temperature slightly above average. Dry. Rather windy. |
| June | 5 | 1.055 | 6 | Sunshine above average. Nights rather cold. |
| July | 10 | 2.6 | 5.40 | Very dry, with average sunshine. |
| August | 12 | 2.79 | 6 | Rather cold month. |
| September | 12 | 1.82 | 5.15 | First half of month, both days and nights were cold. |
| October | 9 | 1.565 | 4.36 | Warmer than the average. Slight rainfall. |
| November | 7 | 1.315 | 2.42 | A warm, dry, sunny month. |
| December | 10 | 2.27 | 0.32 | Average temperatures. Last few days very severe. |

Total rainfall—22.055 inches: below the average.
Number of days on which rain fell—131.
Sunshine above the average.

Temperature on the whole was about the average. There were a few warm spells during June and July, also at the end of September and early in October.

# GENERAL NOTES.

## 1909.

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# GENERAL NOTES.

## 1909.

### PRIZE DISTRIBUTION DAY.

The distribution of prizes and diplomas to the students of Wye College marked the inauguration of the new Session on Saturday, October 9th, a large company gathering in the gymnasium to take part in a function in which the great majority—being students, professors, or Governors of the institution—had a decided individual interest. Mr. M. J. R. Dunstan presided, and was supported by Lord Ashcombe, Messrs. F. S. W. Cornwallis, J. Sayer, H. E. H. Rice, C. B. Edgar, and E. Vinson (Governors), and Dr. Miers, Principal of London University, there being also present Messrs. F. V. Theobald, (vice-principal), H. F. Abell, H. D. Headley, and the members of the staff.

In opening the proceedings Mr. Dunstan gave a briet sketch of work done, saying he was happy to be able to report again continued progress in all departments—progress which was measured not only quantitatively but qualitatively—and he thought he might say that the standard of work and its usefulness both within and without the College had been as high as, or higher, than that of previous years. There were 127 students now in residence, against an average of 125 during the past season, and the increase of the duration of the diploma course had had a good effect in raising the standard of the work done in the College. Three students had graduated at London University as Bachelors of Science and Agriculture, and one had recently been appointed head of the Agricultural Department of Reading College (hear, hear). One had passed the intermediate examination in Science at London University, and four the Associateship of the Surveyors' Institution. As regarded outside work, there had been an increase in the number of lectures given in the county, and in visits to the College by farmers and fruit-growers, the latter testifying to the growing popularity of the College among agriculturists. Of course, it was only on special points in specialised industries that such a College could be of use. The most important side of farming was perhaps the commercial side, and on that it was almost impossible for outsiders without knowledge of all the conditions under which each farm was carried on to give advice that might be of value. They could give information as to the relative value of different varieties of farm crops, manures, and foods, and advice as to spraying and dealing with fungi, insects, or investigate epidemics of obscure diseases of farm stock, but to the general farmer it was a little difficult to give more than general help which might or might not be of much service. He would, however, mention two matters in which the College had helped by its investigations :—the use of the male hop in the plantations had added very much to the quality and the quantity of the crop, and the use of the male hop was now general in the best grounds in Kent, as a result of the action of the College. In the matter of the sale of wool, too, the College might claim to have established a new departure ; but he noticed that those who had taken advantage of the points the College had put before them had hardly been generous-minded enough to acknowledge the source of these advantages. That was human nature, he supposed ; and they must put up with that form of gratitude. Referring to the College, Mr. Dunstan said it was on a thoroughly sound and efficient basis, and those who had visited it had seen that the appropriation which the Governors annually made for the instruction of students on the farm was expended in a wise way. Of course, on a farm primarily intended for the instruction of students with a great range of varieties of crop and stock for the benefit of students, it would be absurd to expect the same results as from a farm on a purely commercial basis, but the produce of the farm, at any rate, compared well with that of others when sold in local markets. Dealing with future developments, the Chairman said it was impossible for the teaching staff to devote the time necessary for research work unless more rooms, more equipment and more men were provided, and the question would arise whether they would not have to reduce the numbers attending the College. It was hoped in the next year to establish a short course for farmers' and fruit-growers' sons. They would have to deal with a large class of men working in a small way, and by means of short courses of four to six weeks they could do real good to those who could not attend the College as long course students, and they would thus get into touch with the small holders, to their mutual benefit. It was also proposed to hold a conference of sheep breeders, when Mr. Cave would lay before them his investigations into the disease of "struck." For all these purposes money was required, and they looked with confidence to the present Government and future Governments for a share of that development grant which had at last emerged out of the field of party political welfare and come into the area of the national good. If it came to be an established fact, he hoped Wye College would have something to say in the spending of some of it (hear, hear). In conclusion, Mr. Dunstan thanked the Governors for the consideration he had always received from them, and the generous way in which they had considered his proposals for the good of the College, and he trusted its present position might appear in some way to justify the confidence they had placed in his colleagues and himself (applause). To his colleagues he owed a greater debt of gratitude for their whole-hearted, self-denying loyalty to him in fair weather or foul. The spade work was done by them; his work was that of the exhibitor, and without their ever-efficient co-operation the College would not have obtained or maintained the position it now held. He acknowledged also the loyalty of all connected with the College—students, superintendents, workmen, servants, and last, but not least, the schoolmasters who attended the summer course—and he would remember it to the end of his life. The welding of the various units of the College into a unanimous whole was one of the causes of its success, and he hoped the feeling would be intensified as the years went on (hear, hear).

Dr. Miers then distributed the prizes and diplomas as follows :—

DIPLOMAS AND CERTIFICATES :—

Diplomas—D. V. Bacon, H. F. Carter, A. G. Cutler, R. F. Hankins, L. Hopkins, C. Vetch.

Certificates—E. R. Cave-Browne, W. W. Brailsford, J. M. Manapat.

Farm Certificate—G. F. C. Warry, E. A. Gray.

The following Students satisfied the Examiners :—

Part II. of the Diploma.—F. A. Bell, L. M. Devonport, E. Deane-Freeman, I. T. Grant, T. H. Holland, C. Lister-Kaye, A. W. T. Nieman, J. A. Pittock, S. Skelton, E. H. Strickland, A. L. Tate, L. Thornley, R. Wellington.

Part I. of the Diploma.—W. B. Barling, D. E. Baxter, G. E. Baxter, J. V. Edge, A. D. Le Sueur, F. W. Page-Roberts.

Part I. of the Agricultural Certificate.—R. B. Strang, C. Sutton-Nelthorpe, A. C. L. Thomas, E. M. Zuppinger.

Part I. of the Horticultural Certificate.—G. C. Addy, A. P. Beatty, G. A. H. Bedford, F. P. Langford, T. B. Mathieson, H. B. Pariss, P. P. Scott, J. G. Sheriff.

DIPLOMA PRIZES :—

Third Year.—Agriculture, C. Vetch, L. Hopkins ; Agricultural Botany, H. F. Carter, *prox. acc.*, C. Vetch ; Agricultural Chemistry, H. F. Carter, *prox. acc.*, D. V. Bacon.

Second year—Book-keeping, Drawing, Building Construction and Surveying, R. Wellington, *prox. acc.*, C. Vetch ; Agricultural Chemistry, H. F. Carter, *prox. acc.*, D. V. Bacon.

Second year—Book-keeping, Drawing, Building Construction and Surveying, R. Wellington, *prox. acc.*, E. H. Strickland ; Veterinary Hygiene, S. Skelton, *prox. acc.*, T. H. Holland, A. W. T. Nieman ; Agricultural Entomology, R. Wellington, *prox. acc.*, S. Skelton.

First year—Agriculture, D. E. Baxter, F. W. Page-Roberts, *prox. acc.*, G. E. Baxter ; General Science, G. E. Baxter, *prox. acc.*, A. D. Le Sueur.

CERTIFICATE PRIZES :—

Second year—W. W. Brailsford.

First year—A. C. L. Thomas.

SPECIAL PRIZES :—

The Agricola Prize for the greatest aggregate of marks in Third Year Diploma Work, C. Vetch.

Horticulture, T. B. Mathieson.

Hedge-layering, G. B. Pinyon.

MEDALS :—

Collection of Botanical and Entomological Specimens, H. F. Carter, *prox. acc.*, A. G. Cutler.

Plans, etc., of Farm Buildings, R. Wellington.

Poultry Management, F. A. Bell.

Practical Farm Work (ploughing, sheep-shearing, etc.), W. W. Brailsford.

The successes of students in outside Examinations were as follows :—

*University of London*—B.Sc. Agriculture, C. J. Alexander, W. B. Burgess, R. Hart-Synnot.

*National Diploma Examination.*—First part, S. Skelton and A. L. Tate.

*Surveyors' Institution.*—Professional Associate Examination, H. F. Foster Pegg, L. Hopkins, C. Vetch, T. B. Worthington.

Lord Ashcombe moved a vote of thanks to Dr. Miers, and, speaking of the work of the College, expressed regret that it was in debt, hinting that a benefactor who should present the Governors with £10,000 or £20,000 would be warmly welcomed. It was a matter of grief to them to have to postpone action brought forward by the Principal supported by the staff. Mr. Cornwallis, in seconding, spoke of the stimulus afforded to the students by the connection of the College with London University. For himself, he did not think any public engagement gave him greater satisfaction than his appointment by the Royal Agricultural Society as their representative on the governing body of Wye College. What they and all connected with the College would like would be to see more members of the County Councils of Kent and Surrey visiting Wye and seeing the application of the money which they voted, for then they would appeal with greater force for whatever funds were necessary for the growth of the institution. During the past year he had had to find one or two capable men in connection with the treatment of Gooseberry Mildew in Kent and Surrey, and he naturally turned first of all to the young men trained at that College, and the men supplied had done their work not only with skill and efficiency, but with such tact and discretion that the co-operation of growers was secured, and in no case had compulsion to be used (hear, hear).

Dr. Miers having returned thanks, Lord Ashcombe proposed a vote of thanks to the Principal and the energetic and active staff, which was seconded by Mr. J. Sayer. Mr. Dunstan, in acknowledging the vote, disclaimed the credit, which he said was due to the staff, who bore the burden and heat of the day. They were proud of the students who had passed through the College, and who were a credit to themselves and to the institution. He had heard of two appointments to agencies in England that day—one being Mr. R. H. Spooner, who did so much for their cricket. Mr. Dunstan also mentioned the fact that three ex-students had within the last two days told him that they had looked for farms practically all over England, and could not find them. Many old students had gone to the Colonies and elsewhere, and Wye might be said to be an Imperial College, with students scattered all over the world.

## INAUGURAL ADDRESS FOR THE 1909-10 SESSION

BY

THE PRINCIPAL OF THE UNIVERSITY OF LONDON,

DR. H. A. MIERS, F.R.S.

Dr. Miers in his remarks congratulated the successful students and also the unsuccessful, if they had made an effort, for an unsuccessful effort, like an unsuccessful experiment, was useful, for without effort there was no education and no advance. A student is not a "passive receiver"; he must make an effort to learn; educational treatises gave minute directions to teachers how to teach, but there were no instructions to learners how to learn. Real training is learning plus teaching; for young children teaching is perhaps sufficient, but in the case of older students there must be an effort to understand made by the learner. A college gives opportunities not only of being instructed by the regular teachers, but also by self instruction, and these opportunities of self-instruction must be eagerly taken advantage of, and a real effort made if the result is to be thoroughly sound and lasting. There is a common misunderstanding about technical training, and the nature of the work attempted by technical colleges. The original Mechanics' Institutes were founded to teach the principles of the art practised, as against rule of thumb, the object of the student being not to learn practice, but principles. This is difficult to accomplish at school, but it is the object of University training, where a spirit of inquiry on the part of the student is essential. The spirit of investigation or research must be cultivated in youth. Pasteur's life is an example of such early cultivation. Research means (1) the cultivation of alertness of mind (example Galileo), the excitement of being on the brink of discovery; (2) the cultivation of the knowledge of general principles (example, Darwin).

Observation without thought, *i.e.*, without a knowledge of general ideas, leads to no advance. Research work without this thought may degenerate into specialised observation. There is a danger in the skilled and practised eye seeing too much if always devoted to the same thing. Sport and games are really better training in observation, but they lack the intellectual effort of thought, and therefore are not complete educationally. Research work may also degenerate into specialised thought and this is the lowest form of specialism which is exemplified in the micro-mammalogist.

There are two methods of escaping specialisation: (1) a knowledge of many subjects (example, Helmholtz); (2) reading everything by wide thought on special subjects (example, Darwin). There is not sufficient time to pursue the first course, but study of general principles is sufficient for the second.

The value of connection with a University lies in the maintenance of a spirit of research, and of the study of principles—these involve an intellectual standard which is upheld by a University. Cultivation must be made of the characteristic of adaptability, which is supposed to be a British characteristic, as is evidenced by our success in colonisation. The obstinacy which is more frequently encountered in intellectual matters, is due to want of thought and general principles.

I should say that in agriculture the necessity of keeping an open mind, of being prepared for any emergency, of inventing new methods when called upon to do so, is urgent more than in any other science. Under new conditions you have to unlearn apparently all that you have learnt by past experience : those who have pursued their studies in a purely technical spirit, who have been brought up like the old-fashioned farmer and the old-fashioned artizan, by rule of thumb, who have learnt to practise agriculture without learning the great scientific principles on which it is based, this adaptability is impossible. But one who has acquired these principles and holds fast to them under all conditions, rather than to the limited experience through which he has learnt them, will be able to confront new problems with a cheerful courage. The only way in which this sort of knowledge can be acquired is by cultivating the research spirit in all our work, by regarding every exercise, every experiment, as containing some secret which it is possible for us to discover by our intelligence, just as any block of marble contains the figure which can only be extracted from it by the mind and the skill of the sculptor. This is the sort of spirit that belongs to University training as contrasted with mere technical training. In your profession many of you will go to the colonies and find entirely new conditions. I hope and believe that the intimate connection of this College with the University of London—a University whose aims and responsibilities are imperial, —will always have the effect of maintaining a high standard of scientific teaching and research. That alone will enable you to send out to all parts of the Empire men capable of applying their knowledge of principles as well as their experience of practice to the new problems by which they will be confronted.

The address, of which the above is a very condensed record, was punctuated with excellent practical illustrations and humorous stories, and was listened to with a close attention which betokened that the audience was in full sympathy with the speaker, and realised the value of the many pointed and useful hints as to the method of development of knowledge which would lead to the best result.

Dr. Miers was very cordially thanked by Lord Ashcombe and Mr. Cornwallis for his valuable address.

## SUMMER TEACHERS' COURSE.

The course for Kent and Surrey Schoolmasters was held from August 16th to 28th, thirty-five attending from Kent and thirty from Surrey.

The course was on the same lines as last year, the principal subjects given being Chemistry by Dr. W. Goodwin, Botany by Messrs. S. T. Parkinson and E. S. Salmon, Zoology by the Vice-Principal, and Bacteriology by the Principal. Other subjects included Agriculture, Horticulture, Land Measurement, Poultry and Beekeeping. In the Botany subject special attention was paid to Fungus Diseases and their Prevention, and a demonstration on the Spraying of Fruit Trees was held in the College grounds. There were special classes for those who wished to learn the preparation of microscopic slides, and they were well attended.

Very keen interest was shown throughout the course, there being considerable improvement in the work compared to that of last year. Owing to the large number of schoolmasters who had attended previous courses, there was considerable difficulty in dividing the classes into Elementary and Advanced, the latter being inconveniently crowded.

A popular lecture was given by Mr. E. Kilburn Scott on "Electricity applied to Agriculture," and the use of the Electric Microscope was demonstrated by the Vice-Principal and Mr. S. T. Parkinson.

In previous years the schoolmasters have always been very generous in showing their appreciation of the way in which the course has been organised and the work carried out, and have at various times made presentations to members of the staff. This year was no exception ; the Principal was presented with a very handsome silver smoking lamp and cigarette case, and Mr. E. S. Salmon with a dressing-case.

The Principal was also presented with the following resolution :—

"The Schoolmasters of Kent and Surrey assembled at the Wye Agricultural College desire to convey to the Principal their high appreciation of the educational value of the Course provided for them, and also of the thorough manner in which it has been conducted. At the same time they wish to express their indebtedness to him for his unfailing consideration, and to assure him of their most cordial and sincere esteem."

## SHEEP-BREEDERS' CONFERENCE.

Mr. Arthur Finn presided at a conference of sheep-breeders, which was held at the South-Eastern Agricultural College, Wye, on Friday, November 19th, at which considerably over a hundred breeders and graziers were present. The most important paper read was probably that by Professor T. W. Cave, F.R.C.V.S., on Struck Sheep, which dealt at great length with the numerous experiments made, and the possibility of a preventive treatment, which had been discovered in the course of these investigations, while the same gentleman also gave an interesting lecture on the Parasitic Diseases of Sheep, and Mr. F. V. Theobald spoke on the Sheep Nasal Fly, and Mr. B. N. Wale on Cropping for Lambs.

Those present included :—G. W. Chitty, Hythe ; J. Lamb, Little Chart ; S. Champion, Sarre ; J. D. Maxted, Garrington ; W. H. Skinner, Boughton Monchelsea ; W. Harvey, Kennington ; W. Maylam, Pluckley ; F. T. Waddell, Mersham ; J. Maylam, Kingsnorth ; R. S. Strouts, Great Chart ; E. Kelsey, Wickham Court ; E. Coulthup, Canterbury ; R. J. Sankey, Croydon ; D. G. Swaffer, Kingsnorth ; E. White and A. White, Beltring ; J. W. Lord, Northiam ; J. G. White, Hythe ; F. Stickells, Newchurch ; R. L. Hetherington, Minster ; G. F. Brown, Margate ; W. Clark, Ospringe ; R. G. Maxted, Wingham ; O. E. Stone, Birchington ; L. W. Laslett, Hamstreet ; H. F. J. Clements, Boughton Aluph ; F. B. Wacher, Canterbury ; J. Stevenson, Paddock Wood ; W. Tabrett, Boughton Aluph ; E. Hambrook, Newington ; J. W. Robinson, Wingham Court ; E. W. Paine, Kingsnorth ; C. H. Bates, Mersham ; E. S. Finn, Lydd ; H. Evenden, Pluckley ; J. G. Benton, Bilting ; T. Champion, Sarre ; G. Goldup, Wye Downs ; E. Hollands, Wye ; H. F. Bensted, Teynham ; E. F. Sinden, Bilsington ; J. File, Saltwood ; E. Fowle, Ruckinge ; C. Collard, Kingstone ; J. F. Greenlees, Adisham ; H. T. Atkinson, Warehorne ; F. E. Baldock, Ruckinge ; J. Clifford, Sheerness ; A. E. Dadds, Hythe ; R. C. Whiting, Faversham ;

R. A. Harrison, Ashford; E. Lord, Ruckinge; J. Long, Wye; S. Swinford, Herne; T. E. Clifford, Sheppey;—Selmes, Newenden; J. Hooker, New Romney; W. Russell, Ruckinge; T. File, Brook; G. Buck, Rotherfield; E. Jarvis, Wye; J. B. Palmer, Lenham; E. L. Blake, Ashford; J. G. Saunders, Canterbury; W. Broadley, Birchington; J. R. Milton, New Romney; H. F. Jones, Bromley Green; G. H. Buley, Woodnesborough; G. Browning, Wye; E. A. Marriott, Ashford; H. Marsh, Nackington; G. Hyland, Bethersden; W. R. Adams, Bishopsbourne; J. J. Adams, jun., Bishopsbourne; E. L. Dixon, Margate; W. Roseveare, Staplehurst; G. Tomkin, Marden; J. Hosmer, Headcorn; J. Sayer, Charing; Dr. O. C. Worthington, Birchington Hall; Major Taylor, Coombe Grove; T. Harden, Bromley Green; the Rev. J. L. Bates, Iden; and others.

Mr. Dunstan said, on behalf of the Governors, he had to extend a hearty welcome to the sheep-breeders assembled, and to assure them that their presence gave them the very greatest pleasure (applause). The College derived something like one-third or a quarter of its income from the ratepayers of Kent, and they were anxious to give those ratepayers every possible advantage from the College resources. They could not do much, he admitted, for the general farmer, but they had touched on industries such as hop growing and fruit-growing, where they could be useful in the matter of insect and fungous diseases. They were suffering, if he might say so, from congestion of circumstances on the land at the present time. They were crowding crops and stock on the land, contrary to the laws of Nature, and in consequence both stock and crops were subject to diseases, and it was in reference to one of them, which was known as "struck" amongst sheep-breeders, that Mr. Cave had for the past eight years been conducting experiments. He had much pleasure in calling on Mr. Arthur Finn to occupy the chair (applause). Mr. J. Sayer, in seconding, said he believed, at such a gathering at this, that the chair should be filled by a man who was thoroughly practical in the subject under discussion.

Mr. Arthur Finn said he had been closely connected with Professor Cave during the past seven or eight years during the time he had been making his experiments with a view to endeavouring to find some remedy for that dreadful disease which sheep in this part of the country suffered from. The loss flockmasters suffered from the disease was enormous, and he heard from a man who collected skins in one part of the district that in a single week in a recent bad spring, he collected no fewer than 1,500 skins himself. This showed the great benefit sheep-breeders would derive should Mr. Cave be successful in finding a remedy, and they all appreciated the work that was being done at Wye College. Here efforts were made, not for the financial betterment of those engaged in the investigations, but to obtain the best scientific results for the benefit of all (applause).

Professor Cave then gave his paper on "Struck" Sheep, a verbatim report of which will be found on p. 363.

In reply to a question at the end of his paper, Mr. Cave said the disease was most prevalent in the Marsh, but it also occurred in other parts of the county. There was no doubt sheep were more liable to it in the low-lying districts. Mr. D. G. Swaffer asked on what sheep the experiments had been made. Mr. Cave said they had experimented on wether tegs. He did not anticipate any danger in administering to in-lamb ewes. In reply to a further question, he said that it was most essential that the carcases of struck sheep should be destroyed, if possible burned, all with the exception of the wool, which might be clipped off. Mr. Hickman asked if the cold had any bearing on the disease. The sheep were found dead mostly on the frosty mornings of early spring. Mr. Cave said he did not think if inquiries were extended over a large area that this was the case, for they sometimes got their heaviest losses in April, and some weeks later. Mr. R. G. Maxted asked if breeding ewes were more or less susceptible. Mr. Cave replied that he had only seen one serious loss amongst ewes—it was generally the wether sheep which were affected. Mr. Buck, of Rotherfield, advocated dressing the pastures with salt as a preventive measure. Mr. Pankhurst said he had suffered heavy losses at East Guldeford, and was willing to give Mr. Cave's specific a trial. Mr. J. W. Lord said he would be pleased to dose a hundred sheep, and another flock owner from Sheppey said the graziers there would be willing to give it a trial. Mr. Arthur Finn said he himself had tried salt, but he did not think it had had any effect. He had always experienced the heaviest losses following a dry summer, when the land had been grazed very hard. He would in future be pleased to give Professor Cave all the assistance he could, and he was sure they all wished to thank him for his interesting lecture (applause).

Mr. Cave was followed by Mr. F. V. Theobald (Vice-Principal), who read a paper on the "Sheep Nasal Fly" (see p. 98), after which an adjournment was made for luncheon.

Luncheon was served in the refectory, and following the toast of the King, submitted by the Principal, Mr. Arthur Finn proposed the health of Mr. Dunstan. He thanked him for his hospitality that day, and the excellent arrangements made, which had proved of such benefit to sheep-breeders, and expressed the hope that Mr. Dunstan's reign of prosperity at Wye College would long continue (applause). Mr. Dunstan, in reply, said the object of the College was to help the agricultural industry. They could not do a great deal, and what they could do they could only do with the co-operation of agriculturists. He hoped for a continuance of that co-operation which had been given in the past, so that the College might not be merely a provincial college, but a national one. The College needed more support from the Board of Agriculture, and this proposed development grant, although it would take money out of one pocket and put it into another, would, he hoped, be helpful to the College. Researches could not be carried out in a short time, and many of their experiments must extend over years, and therefore he asked from agriculturists a certain amount of patience. He hoped their usefulness would go on increasing, and that criticisms would be made by those who knew what they were criticising, for those they could answer. In conclusion, he proposed a vote of thanks to Mr. Arthur Finn for presiding that morning (applause), and announced that the chair would be taken in the afternoon by Mr. Stephen Swinford.

Mr. Cave read a second paper in the afternoon on "Parasitic Diseases of Sheep," a full report of which will be found on p. 367.

In the discussion which followed, Mr. Dixon said Mr. Cave had spoken on the two diseases, "struck" and parasitic diseases, and the keynote of his discourses had been curative rather than preventive. Their thanks were due to Mr. Cave, and he hoped he would long be spared, not only to the staff of this College and the stock-owners in general, but likewise to the students, who went to all parts of the world, and must of necessity take with them that knowledge so essential to success (applause). Mr. Hickman said that in America it was the practice to give the sheep tobacco leaf with the salt, instead of the sulphate of iron. Mr. Maxted said worm in the throat was no new disease, and in 1865 he lost sixty-one lambs out of 300 from it. He determined then to kill or cure, and used sheer turpentine, applying half a teaspoonful to each nostril, and rubbing the throat with the other half. He had used that remedy ever since, and had found it most beneficial. Professor Cave said he would not use it himself, and did not believe that the fumes of turpentine could kill worms which could live for ten minutes in chlorine.

Mr. B. N. Wale's paper on "Cropping for Lambs," which will be found on p. 375, brought the Conference to a close.

## VISIT OF THE ARCHBISHOP OF CANTERBURY.

On Tuesday, December 7th, the Archbishop of Canterbury paid a visit to the College, and a special service was held in the parish church at twelve o'clock for the staff and students. They attended in full force, the number of members present being over 150. The service was conducted by the Vicar, the Rev. S. H. Rendall. His Grace, who preached, took as his text, "Add to your faith virtue" (2 Peter i. 5), from which he preached a most impressive sermon, treating of the two sides of a man's life, and explaining that the adding of virtue was meant to show that faith must be practical, that as a result of faith they must be strong and robust to fight against evil, and have a good influence over all with whom they came in contact.

The Archbishop was afterwards entertained to luncheon in the Gymnasium, the Principal, Mr. M. J. R. Dunstan, presiding, and being supported by the Rev. E. L. A. Hertslet (Archbishop's chaplain) the Rev. S. H. Rendall, Colonel C. S. Hardy, the Rev. J. A. Halloran, the Rev. G. W. Elnor, Messrs. W. E. S. Erle-Drax, F. H. Abell, F. V. Theobald (Vice-Principal), and the other members of the staff, the students occupying the body of the hall.

After the toast of the King had been loyally drunk, the Principal said he felt he was only voicing the wishes of those present when he expressed their thanks to his Grace for his visit there that day —(cheers and applause)—and for the words he spoke to them before luncheon, which he felt certain would prove a great help to very many of the younger members there, not only that day but every day in their lives (applause). The connection between the Church and agriculture dated back a great many years, and when one looked through history and studied the manner in which agriculture had improved in this country, one found that that improvement was due mainly to the religious houses which were established and which administered large tracts of land in the Middle Ages. It was they who taught agriculture in those days, and when that College was founded by a former Archbishop of Canterbury, it might have been that in the past it had some influence on agriculture, influence which they hoped it was having at the present time. Their founder had as part of his crest three wheat sheaves, and that part of his crest they had taken for the College, and he always felt that it was a very happy augury for the harvest of useful work which was going to be accomplished. It was an excellent emblem for an Agricultural College, and he trusted that harvest was being reaped from their work at the College. His Grace's visit also signified something deeper. The College itself was non-political and undenominational, but while non-political meant that they had no politics, he trusted that undenominational did not mean that they had no religion. Their religion, conduct and education were their three strongest points in life, and when one asked oneself " Is my life successful," he was quite sure that without religion one would never be able to answer " Yes." He felt really thankful to his Grace for coming that day, and in the midst of his many engagements they deemed it an honour that he should have come, and a privilege to listen to those words of wisdom and advice he had given them that morning. He regretted that the Rt. Hon. Lord Ashcombe (chairman of the Governors) had been detained in London through the fog, but on behalf of the Governors, staff, students and everyone connected with the College, he offered his Grace hearty thanks for his kindness in coming amongst them (prolonged applause).

On rising to reply, his Grace was enthusiastically received, and in the course of his remarks said that genuinely he could say he had been touched and helped by the words their Principal had spoken, and by the kind way in which they had received him. For a man doing the type of work which he had to do, the majority of which was done in study, in correspondence, by organisation—in short, the dullest and most prosaic of all work, it was a genuine help to have the opportunity of coming into straight touch with men in the living realities that belonged to their lives—in the largest sense of the word. He felt that Kent had a great deal to be proud of in Wye College, and also that the county was under a debt to it—a debt which England and the English people outside our own shores, who knew what that corner of England had done as centuries had gone by, would fully realise. If they searched history they would find that it was from Kent that immense impulses went forth—in religious life, in architectural life, in education ; and therefore they would not be surprised to learn of other great things being started—their great naval base at Dover, and more it was actually stated (although he did not wish to commit himself) that they were going to have a coal-field of their own (laughter). One of the other ways in which Kent was leaving its mark on England was by the work being done at that College, and by the men who went out from there, and whose lives and work, quite apart from the technical knowledge they acquired there, made them respected and looked up to by all. He had personal knowledge of that, and felt that the country owed a debt of gratitude for the work which was being done at Wye College under the present governorship and presidency (applause). He was quite certain if they could send out into the rural life of England and our Colonies and Dependencies men who were not merely experts in any particular subject or subjects, but who had grit and backbone, and would carry out all that was right, manly, robust, and straightforward in our English life, and would imitate all that we liked to think of as best in our English character, we should be doing something which would prove an enormous gain to the Kingdom here at home, and our Empire beyond the seas. Mr. Dunstan had said that the Church had done a great deal for agriculture, and that was true, for the Benedictines were the teachers of perseverance as well as knowledge, and under great difficulties taught us what was the best of rural work and what was the progress in agricultural life. Perhaps the time had come now, however, for a return of those favours, and that the Church, which was trying to set up morals, good living, and a high tone throughout the world, would find itself being helped by Agricultural Colleges sending out men who would support what the Church strove to attain in promoting that tone, purity and strength of body, creating that force of example in the things they did that would be followed by those among whom they worked and by others as well. If that was so, then they owed a further debt of gratitude to the College, and he honestly believed that that was what a group of fellows in a place like that could bring about in a constantly maintained circle like there was at the College, doing more and more for the progress and good of a vast number of people who did not think at all, and upon whom they were intellectually capable of producing an immense effect. He rejoiced to know that there existed a place like that ; that so high a standard was set within its walls, and that they were able to carry it out. He prayed that the blessing of God might rest upon them in their life there, and that grand results might follow from the foundation of that College and from the work they were doing for God and for man in this world (applause and Kentish fire).

After luncheon the Archbishop made an inspection of the College buildings, under the guidance of the Principal, and then left to hold a confirmation in Wye Parish Church.

# WEATHER NOTES, 1909.

| | Number of days rain fell. | Inches of Rain. | Average daily Sunshine. | Remarks. |
|---|---|---|---|---|
| | | | h. m. | |
| January | 9 | 1.06 | 1.42 | A moderately warm, rather dry month, with very little wind and average amount of sunshine. |
| February | 9 | 1.025 | 2.40 | An exceptionally cold February. Sunshine above the average and a slight rainfall. |
| March | 22 | 3.795 | 2.2 | Cold, very wet and sunless. Rain, hail or snow fell on 22 days making a total of 1¾ inches above the average. The sun shone 1 hr. 40 m. a day less than average. |
| April | 11 | 1.41 | 6.55 | Warm and sunny, with an average rainfall. Sunshine almost 2 hours a day above average. |
| May | 6 | .77 | 7.40 | The sunniest month of the year. The rainfall was 1¼ inches below the average, and most of that fell on the last few days. |
| June | 12 | 3.155 | 3.40 | Dull cold and wet Sunshine less than half the average. |
| July | 16 | 3.375 | 3.50 | Very cold and wet. |
| August | 9 | 2.585 | 5.40 | On the whole a rather warm August. The first seventeen days warm and dry. The remainder cool and wet. |
| September | 18 | 3.61 | 3.56 | Cold and sunless. |
| October | 21 | 6.145 | 2.10 | A very wet month. The rainfall about 2¾ inches above average. |
| November | 7 | .765 | 3.20 | A dry, cold and sunny month. The rainfall was less than ⅓ of the usual November average. |
| December | 19 | 4.115 | 1.24 | A warm and very wet month, average amount of sunshine. |

*Temperature.*—A very cold year. May to September inclusive were very cold months.

*Sunshine.*—Although such a very wet year the sunshine, compared with the last three years, was up to the average. May was the sunniest month.

*Rainfall.*—Total 31.81. Far above the average for this district, the rainfall for the three preceding years being 25.77 in 1906, 23.44 in 1907 and 22.05 in 1908.

## STAFF PUBLICATIONS.

### By F. V. THEOBALD.

1. A Monograph of the Culicidae of the World. Vol. V. pp. 644 + x. and 261 figures (1910).
2. The Insect and Allied Pests of Orchards, Bush and Hot-house Fruits, pp. 550 + xvi. and 328 figures (1909). 30s.
3. The Insect and Allied Pests of the Hop. *Board of Agriculture Journal,* Vol. XVI., Nos. 7 and 8, October, 1909, pp. 555-571 and November, 1909, pp. 617-628 + 6 plates.
4. Descriptions of the New Mosquitoes collected by Dr. Graham in Ashanti. Colonial Office Report, Miscellaneous, 237. May, 1909, pp. 27 + 3 plates and figures. (*Printed for use of the Colonial Office*).
5. Washes used as Insecticides and Acaricides and Principal Washes used as Sprays against Insects and Mites. *Journal Royal Horticultural Society,* Vol. XXXIV. Part III., pp. 326-357. 1909.
6. Poultry Lice. *The Illustrated Poultry Record.* + 6 figures.
7. The Apple Sucker and its Treatment. *Irish Gardening,* Vol. IV., No. 17, pp. 33-35 + 8 figures. March, 1909.
8. Gapes in Poultry. *Live Stock Journal,* Christmas Number, pp. 203-205. 1909.
9. Poultry Fleas and the Red Hen Mite. *Illustrated Poultry Record.* pp. 92-94. November, 1909. + 2 figures.
10. The Garden Chafer (*Phyllopertha horticola*). *Agricultural Gazette.* June 21st, 1909.
11. Second Report on the Culicidae in the Indian Museum, Calcutta. *Records of the Indian Museum,* IV., 1., pp. 33 + 3 plates, 1910.

12. A New Culicid Genus (*Newsteadina*). *Annals of Tropical Medicine and Parasitology*. Vol. II. No. 4, p. 297. Feb., 1909.
13. Articles Economic Entomology. *The Standard Cyclopedia of Modern Agriculture*. Vols. I., II., III., IV., V., VI. and VII. (1909).
14. New Mosquitoes from the Sudan, and List and Synoptic Table of all the known Sudanese Species. *Third Report of the Wellcome Research Laboratories at the Gordon Memorial College, Khartoum*, pp. 249-267 + 6 plain and 1 coloured plate. Khartoum. (1908).
15. Report on Economic Zoology for year ending April 1st, 1908. Pp. 119 + 46 figures. Ashford. (1908). 2s. 6d.
16. Summer Washes for Fruit Pests. Leaflet 10.

### By DR. W. GOODWIN.

The Scientific Feeding of Animals. A translation of Kellner's *Grundjüge der Futterungslehre*. Pp. XIII. 404. Publishers, Duckworth & Co. 6s.

### By E. S. SALMON.

1. The American Gooseberry-mildew. *Kent County Examiner* August 21st, 1908.
2. The American Gooseberry-mildew attacking Red and Black Currants. *Gardeners' Chronicle*. September 12th, 1908.
3. The American Gooseberry-mildew. *Fruit-grower*, September 17th, 1908.
4. The New Potato Disease. *The Times*, September 21st, 1908.
5. The American Gooseberry-mildew in Surrey. *l.c.*, October 3rd, 1908.
6. *Uncinula incrassata*, a new species of *Erysiphaceæ* from Africa. *Annales mycologici*. Vol. VI. No. 6. (1908).
7. The Black Scab of Potatoes. *The Times*, November 9th, 1908.
8. *Idem*. *The North British Agriculturist*, November 19th, 1908.

9. Apple Scab or Black Spot. *Leaflet of the South-Eastern Agricultural College (revised).*
10. Bordeaux Mixture. *Fruit-grower,* December 10th, 1908.
11. Plant Pests and Legislation. *Journal of the Royal Agricultural Society of England.* Vol. LXIX., pp. 122-132, 1908

By T. W. Cave.

1. Note on the Methylene Blue reaction with Anthrax Blood.
2. Sheep Foot Scab Mite. *Journal of Comparative Pathology and Therapeutics.*

By Cecil H. Hooper.

1. Notes on the time of Blossoming of Fruit Trees. *Journal of the Board of Agriculture,* December 1908, pp. 678-687.
2. The Influence of Geology on Horticulture. *Journal of the Royal Horticultural Society,* March, 1908, pp. 394-410.
3. Small Fruit Growing in Kent. *Journal of the Board of Agriculture,* November, 1909. Vol. XVI., pp. 628-635.

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